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PC MAGAZINE

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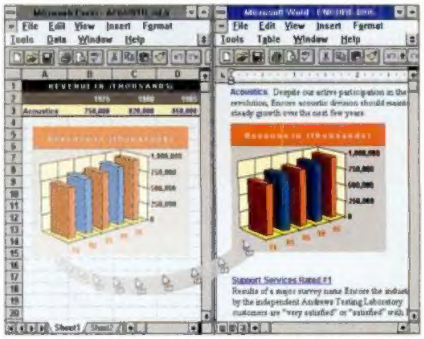

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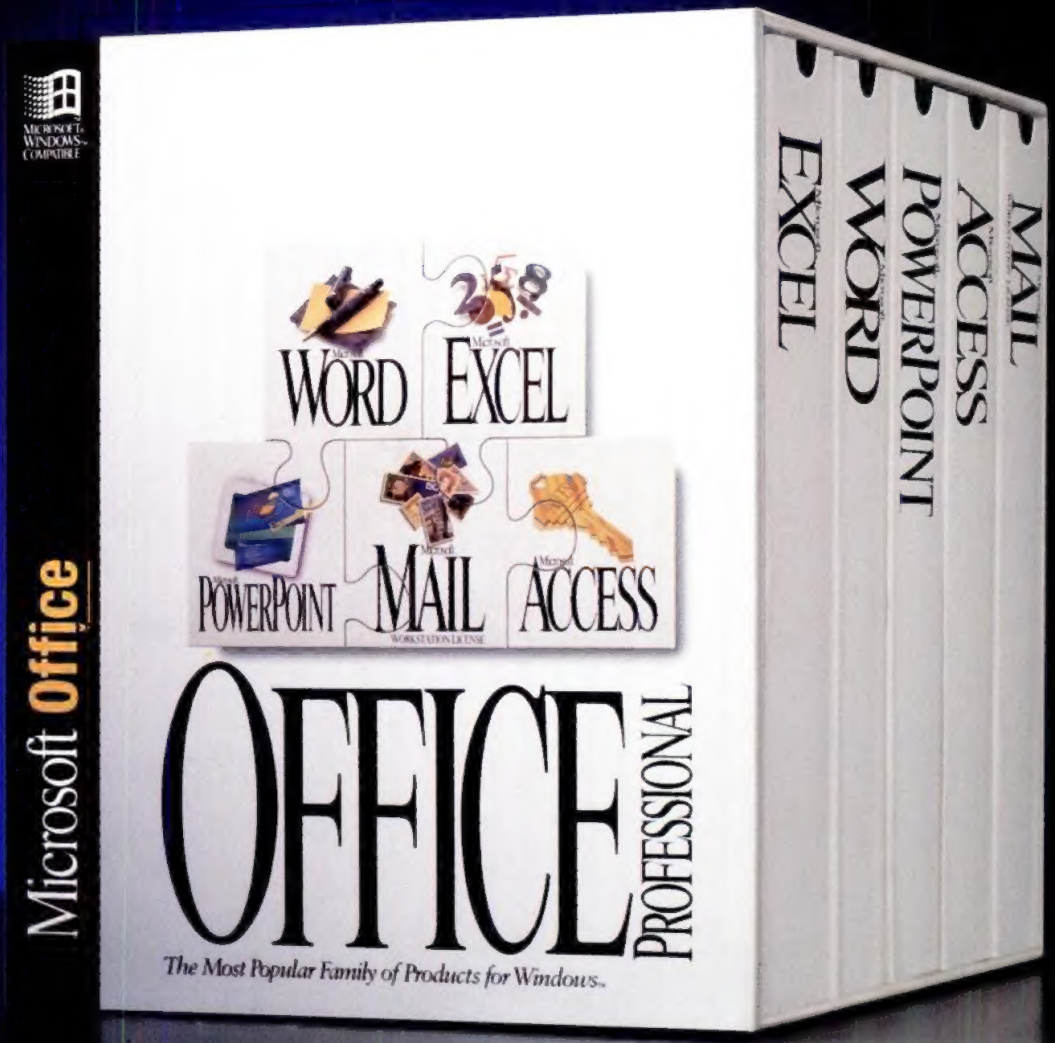

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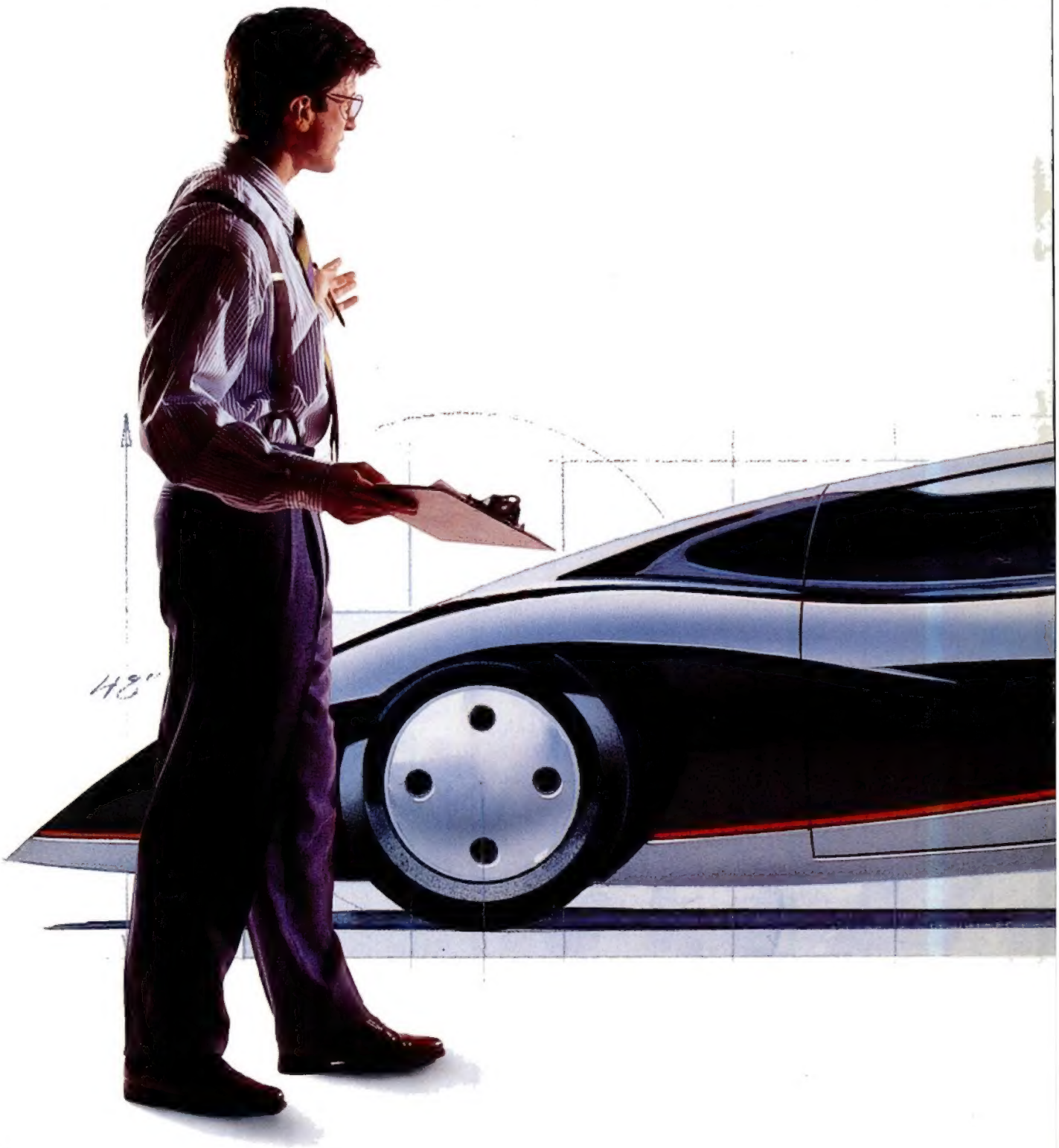

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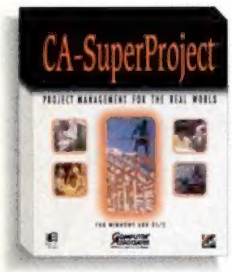

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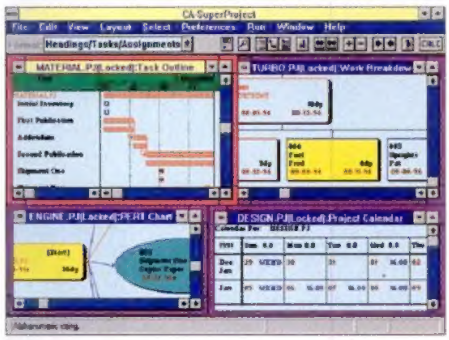

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Inside

Over the past year, the pages at the back of *PC Magazine* have undergone a subtle but noticeable improvement. Our technical section was strengthened with new columns aimed at helping corporate developers and at extending your applications. The entire section was redesigned and given a new title: PC Tech. And PC Tech was imbued with a new sense of intelligence, technical accuracy, grace, and humor.

Dale Lewallen.

Much of the credit belonged to Dale Lewallen, who joined us last August as a senior editor, following a long tenure at *PC/Computing*. Dale worked with associate editor Sharon Terdeman and a crew of loyal, hard-working staffers and contributors to make the section what it is; he brought to the magazine a strong commitment to the computer industry, to the people who worked with him, and to his family. He could always be counted on for a level-headed opinion, a good-humored story, or a well-placed word of advice. He had a blend of technical prowess, editorial acumen, and management skill that made for great copy.

And now Dale is gone. On a recent Friday evening, he left the office and suffered a heart attack on the train ride home. He was only 32 years old.

In his short tenure here, Dale touched just about everyone. "Dale was one of the most optimistic, positive people I've ever met," says staff editor Michael Muchmore. "He always wanted us to flex our muscles and try new things if they made sense. He imprinted his upbeat character on the PC Tech section. The titles are catchier, the language is more cheery, the design grabs you more, and the coverage is broader. These are all things he worked on and achieved."

Ellyn McCasland, staff editor, says, "Dale always stood out, but it is his smile, warm and contagious, that stands out in my memory now. And he had a smile for everyone." She continues, "Dale was a terrific manager. He was intelligent, enthusiastic, supportive, diplomatic, efficient, and optimistic. Dale was always willing to take the time to share his knowledge with us and to teach us better ways to do things."

Dale had a rich professional life outside of the magazine, too. He was the author of *This Old PC* and other computer books. He was a constant presence on-line. His personal life was centered on his family. Despite a demanding job, he always made it a priority to get home on time to be with his wife, Lysa, and daughter, Kirsten.

Dale's departure leaves a large void at *PC Magazine*. Everyone who knew him personally and professionally, both at *PC Magazine* and throughout the entire computer industry, will miss him tremendously. PC Tech is a better place for having had him.—*Michael J. Miller*

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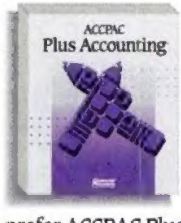

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100-MHz DX4 PCs

DX4: The Value Performer

BY MIKE FEIBUS Intel's new clock-tripled DX4 chip has injected new life into the 486 class of PCs by providing performance close to the 60-MHz Pentium level at a much lower cost. At PC Magazine Labs, we put 26 new DX4 desktops through our benchmark tests to find out just how much performance you can expect for your computing dollar 112

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90-MHz Pentium PCs

The Pinnacle of Power

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End User Databases: Balance of Power

BY SAL RICCIARDI Balancing power with ease of use is no easy stunt, but end user databases are finally getting the hang of it. Today's end user database products are powerful and feature-rich, yet far easier to work with than anything that's come before. Their secret lies in logical interface design, intuitive WYSIWYG tools, and automated help to guide you along the way. We test seven end user database packages for performance, ease of use, and suitability for a range of typical end user chores **227**

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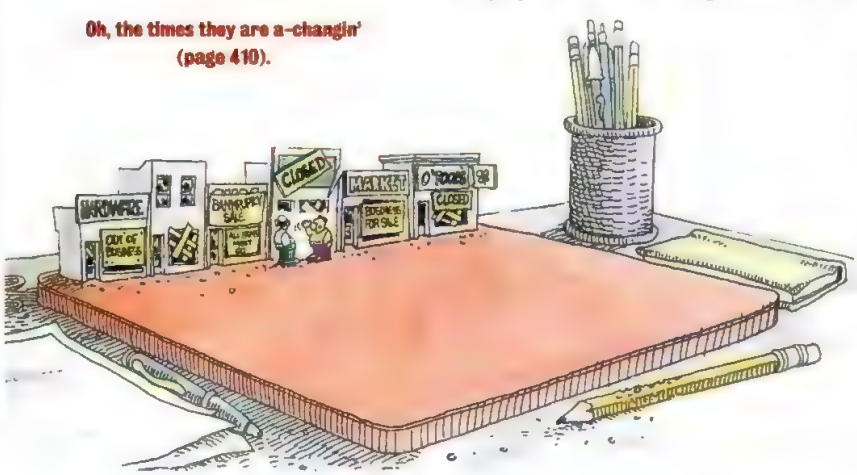

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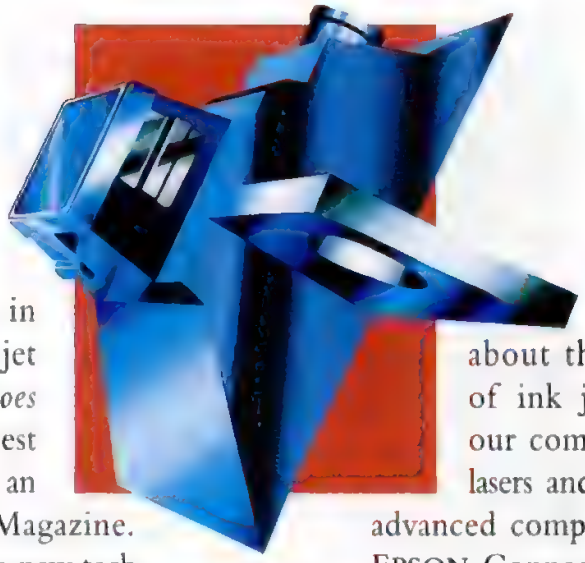

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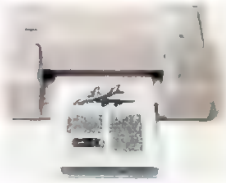

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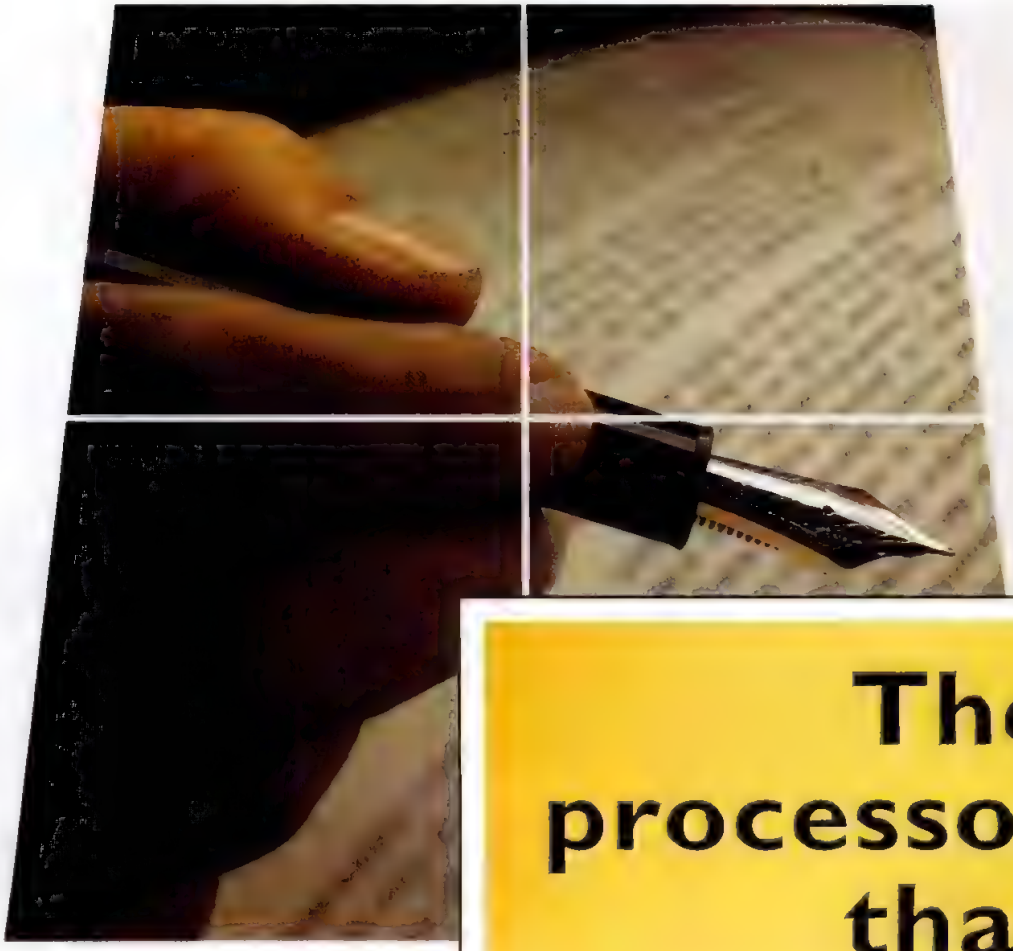

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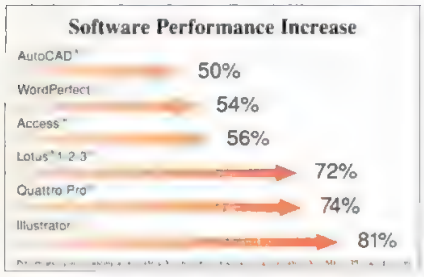

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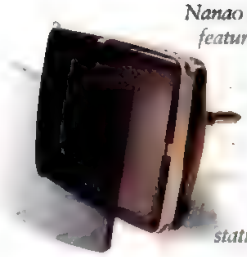

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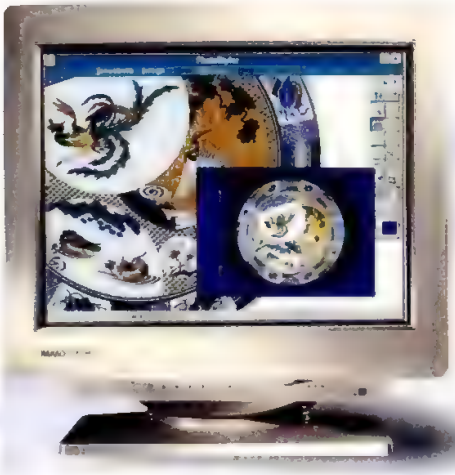

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CIRCLE 283 ON READER SERVICE CARD

Letters

INFO-HIGHWAY CONGESTION

It was with deep concern that I read Jim Seymour's column "Will the ISH Be a One-Way Street?" (April 12, 1994). Before we become concerned with "carriers of choice" and "send and receive," we must be concerned with who will fund this Information Superhighway. My local BBS is extremely inexpensive (just like a dirt road), but I don't have access to all the benefits of the ISH. I joined an interstate system (Prodigy), and that went well until the rates started climbing higher and higher. The ISH will be an expensive toll road and travelling it will be a casual road trip for some and a daily commuter experience for others. The degree to which the ISH permeates society will become dependent upon the costs of taking this toll road, and although the ISH will move forward and grow, not everyone will be on it. Some of us will prefer the road less traveled.

Terry J. Dransfield
Syracuse, New York

Seymour states, "I don't know about you, but I'm just about ISHed out. The endless drumbeat of cutesy speculation passed off as reporting and analysis on the proposed Information Superhighway has gotten pretty tiring." I agree with him 100 percent, but if he's truly "ISHed out," why is he boring us with yet another "tiring" article about the Information Superhighway?

Chris Richardson
via PC MagNet

Contrary to Seymour's assertion, the Information Superhighway is not a bad metaphor; it is simply the most effective term to help people—even computer-literate people—understand exactly what they're facing, and of what value it may be to them. Compared with what we have now, the idea of any legitimate two-way digital channel to the home is downright seductive, and I agree with Seymour that it would be nice to have a gigabit-per-second two-way channel to the home. But instead of just imagining how great it would be to have all that bandwidth, let's implement something now and allow market forces and application availability refine the system later.

Glenn Foulke
Lake Lotawana, Missouri

Jim Seymour
Will the ISH Be a One-Way Street?

The Information Superhighway will be an expensive toll road.

UPS REVISITED

"Keeping Up with UPSs" (September 14, 1993) discusses the various factors required in selecting a proper UPS and compares UPS product offerings. The article, however, requires some clarification as to its discussion of the Liebert AccuPower Gold Model 750.

The AccuPower Gold successfully passed *PC Magazine*'s 5-minute blackout testing, as well as prolonged blackout testing subsequently conducted by *PC Magazine*. Both of these tests included the initiation of an orderly shutdown of first the file server and then the UPS. Liebert Corp. and *PC Magazine* have since concluded that the originally reported AccuPower Gold test results were affected by a ZD Labs test engineer's incorrect configuration-code entry during installation of monitoring software.

The article also reported remote monitoring as being unavailable. In fact, all AccuPower Gold UPS units include RS232 communication ports and relay contacts to allow monitoring of UPS status.

Additionally, a fully comprehensive treatment of the subject of UPS selection would have included a more completely developed discussion of topology and application of the featured UPSs. The three topologies used in today's market are: off-line (standby), line interactive, and on-line. UPS pricing reflects the topology used, with on-line being the more expensive and—in appropriate situations—the proper alternative for same-size UPS units. When you are selecting a UPS, topology and application are a legitimate part of the necessary evaluation process.

John Fuchik
Product Manager
Liebert Corp.
Columbus, Ohio

SHINY DISTRACTIONS

In spite of being distracted, Bill Machrone hit the mark dead center in his column "Distracted by Something Shiny" (April 12, 1994). I also get "really cranky" about the icon fixation of so many software developers. Having to memorize the meaning of obscure icons for each program is, in principle, no different from having to memorize obscure and unique command line commands for each program you use. The point of Windows (aside from the fact that it offers better memory management and multitasking capabilities) and icons is to provide some consistency and ease of use from program to program. Not so if I can't figure out what the cute but meaningless icon represents.

Herman J. Smith
via PC MagNet

My congratulations to Machrone for finally saying something that needed to be said. I really enjoyed and related to the comments in his April 12 column, since lately I've been wondering if I went through the trouble of learning to read for nothing. The little pictures may be nice, but just as the first time I had to use the windshield wipers in a car without a switch labeled "wiper," I find it annoying trying to interpret hieroglyphics when I'm in a hurry.

William Harvey
Natalia, Texas

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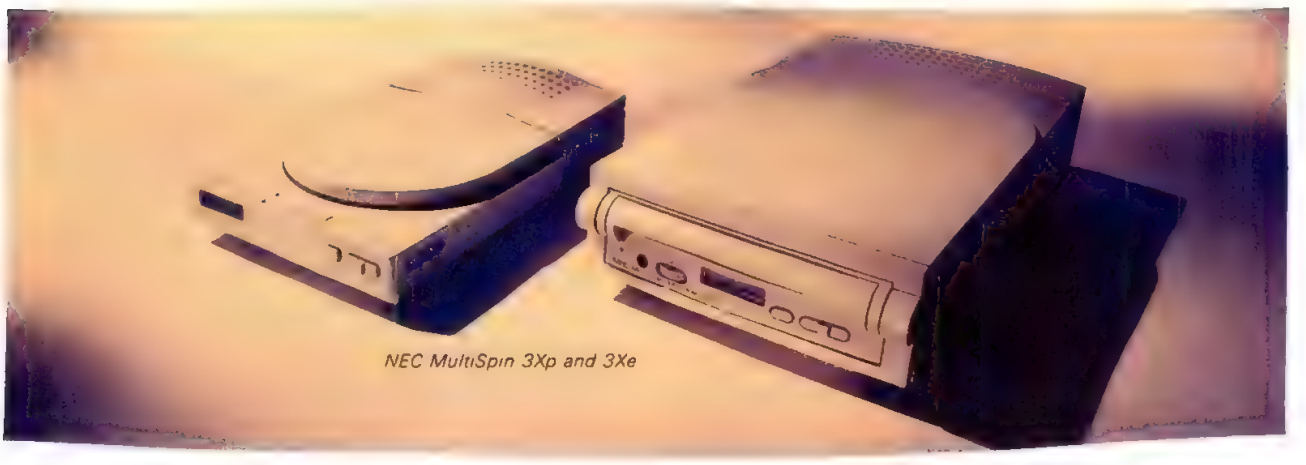

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CIRCLE 157 ON READER SERVICE CARD

LETTERS

LEASHING PENTIUM'S POWER

In your evaluation of Pentium machines ("Unleashing the Power of Pentium," April 12, 1994), you failed to mention how ludicrous it is to install DOS or Windows on a Pentium. It's like flying an F-15 with a World War II–era instrument panel.

Edward S. Fisher
Marlboro, New Jersey

CRACKING OPEN A MYTH

Although I found myself nodding my head in agreement with Michael J. Miller's "The Myth of Usability" (April 12, 1994), I had to wonder what he was thinking when he said it would be a good idea to put a software package's entire manual on-line and do away with printed documentation. A printed manual should be written so that it takes advantage of its skimmability, while an on-line help system should exploit its ability to give context-sensitive and cross-linked information that's just an F1 key away. I'll rue the day that Microsoft discovers in usability tests that a multimegabyte on-line representation of a 700-page manual is better than the printed version.

Joel Hock
Carlisle, Pennsylvania

FLIGHT AND FANCY

It was disappointing to see no mention of the freeware Pegasus Mail in your roundup of electronic-mail products ("The E-Mail Personae," April 12, 1994). After using a commercial product, and paying more than $1,000 in license fees while waiting days for tech support, I find using Pegasus Mail to be a pleasure. The product is feature-rich and easy to use, and tech support is readily available either via a Usenet on the Internet or directly from the author via CompuServe or the Internet.

John H. Adams
via the Internet

• We were aware of David Harris's Pegasus Mail and the program's popularity worldwide. In fact, we invited Mr. Harris to submit Pegasus Mail for review, even though it doesn't offer a true remote client. After several rounds of correspondence, he ultimately declined the opportunity to be included, saying, in part, "I have now decided that I would prefer that you did not include my program [Pegasus Mail] in your review. I'm appreciative of the offer and grateful that you took the time to contact me."—Ed.

STACKING THE DECK

In your roundup of stackable hubs ("A Hub Above," January 25, 1994), we found inconsistencies in the treatment of some features. Specifically, Cameo Communications offers SNMP upgrade in two ways, yet the reviewer gave the Cameo UltraHub 1000 a *poor* rating for ease of SNMP upgrade. In contrast, the SynOptics LattisHub 2803 received a *good* rating for the same task, even though the reviewed SynOptics hub does not have the same flexibility. In addition, our UltraView SNMP management software costs about $3,000 less than SynOptics's Optivity software.

You also overlooked Cameo's out-of-band management features; the Cameo UltraHub can alternate between in-band and out-of-band very easily. And you didn't cover extendibility, which we emphasize in our product line.

F. Alan Brind
Executive Vice President, Sales and Marketing
Cameo Communications Inc.
Nashua, New Hampshire

• You can buy Cameo UltraHub 1000 hubs, which are unmanaged units that you can upgrade to UltraHub 1010 status for managing with an UltraHub 1020 unit. You can also buy Cameo UltraHub 1010 hubs outright, which are comparable with the SynOptics 2803 hubs. Thus, Cameo offers users flexibility in purchasing and SNMP upgrade. We take this into account, but we also note that at the time of testing, the documentation was weak and some extra steps were involved in some upgrade areas. We adjust the rating to *fair*. Cameo has acknowledged some of the drawbacks we mentioned and, since the review, has addressed many of them in its products. Finally, in-band and out-of-band management features and extendibility are two interesting aspects of stackable hubs that we'll likely consider the next time we look at this market segment.—Ed.

We would like to elaborate on some points raised in your review of our D-Link DE-1200 stackable hub. Our product ships complete with both 12 RJ-45 connectors and a Telco-50 Module that is easily interchanged at no additional charge. And unlike some vendors, we give users the choice of buying support for monitoring the workstation upon which the SNMP management software runs. In addition, our D-View software includes auto-discovery for locating SNMP devices on the network, and our MIB Browser manages third-party SNMP devices.

Steven H. Joe
Marketing Director
D-Link Systems Inc.
Irvine, California

CORRECTIONS AND AMPLIFICATIONS

The April 26, 1994, New & Improved column mentioned that Solomon Software's Solomon IV for Windows had replaced Solomon III. Although the code has been rewritten for the new version, Solomon III will continue to be sold to DOS users.

The May 17, 1994, New & Improved Hot Prospect said that the IBM RISC System/6000 N40 uses a Motorola PowerPC 601 processor and is the first portable to run Unix. The PowerPC 601 was developed by Apple Computer, IBM Corp., and Motorola but is only being manufactured by IBM. Also, the system is the first PowerPC-based portable to run AIX, IBM's version of Unix.

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Every member of the TravelMate family features a powerful 486 processor – up to 75MHz. Combined with monochrome or brilliant color displays, superb battery life, and a variety of configurations, you can be more productive even when you're on the go. The TI TravelMate notebooks – there's a perfect mate for you.

The perfect desktop replacement. The TravelMate E Series.

Looking for the expansion capabilities of a desktop coupled with the portability and convenience of a notebook? Turn to the TravelMate 4000E Series. Partner the TravelMate 4000E with TI's Intelligent Docking System and you have the ultimate desktop PC replacement. Just insert any of the eight models of TravelMate 4000E notebooks into the Intelligent Docking System, push a button and the auto-load mechanism does the rest. Your TravelMate 4000E is now automatically configured as a desktop PC. It knows whether you have an external monitor, keyboard, internal modem and

The TravelMate Notebooks Now there's a perfect

TravelMate E Series

- Eight 486 models ranging from a 25MHz up to a racy IntelDX4™/75MHz
- 4mm full-travel keyboard with a desktop feel, Microsoft BallPoint™ mouse with QuickPort™ connection
- Disk storage from 120MB to 455MB
- Desktop Replacement: Intelligent Docking System with 6 ISA and 2 PCMCIA card slots as well as 4 drive bays for additions such as hard drives, CD-ROM, tape drives and more

intel inside

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other peripheral devices. When you're ready to hit the road, simply click an icon and the system saves the files you're working on, closes Windows™ and ejects your TravelMate 4000E. Then you're on your way – that's true desktop replacement.

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If you're looking for a notebook computer that is multimedia-ready, TI brings you the new TravelMate 4000M Series. From the moment you see our TravelMate 4000M, you'll appreciate how much performance it packs into its sleek new design and conveniently located integrated pointing device.

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To find out how you can get together with the ideal TravelMate, just call **1-800-TI TEXAS** (1-800-848-3927). We'll help you find the perfect mate.

from Texas Instruments.
mate for everyone.

TravelMate M Series

- Four 486 models ranging from a 25MHz to a racy IntelDX4™/75MHz
- Built-in PCMCIA slot, integrated pointing device, SCSI II interface, 16-bit sound, internal microphone and speaker, and a 16-bit MIDI port
- Disk storage from 120MB to 340MB
- Portable CD-ROM Docking System option with a double-speed CD-ROM drive and built-in stereo speakers

EXTENDING YOUR REACH WITH INNOVATION™

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CIRCLE 139 ON READER SERVICE CARD

It runs
even its price

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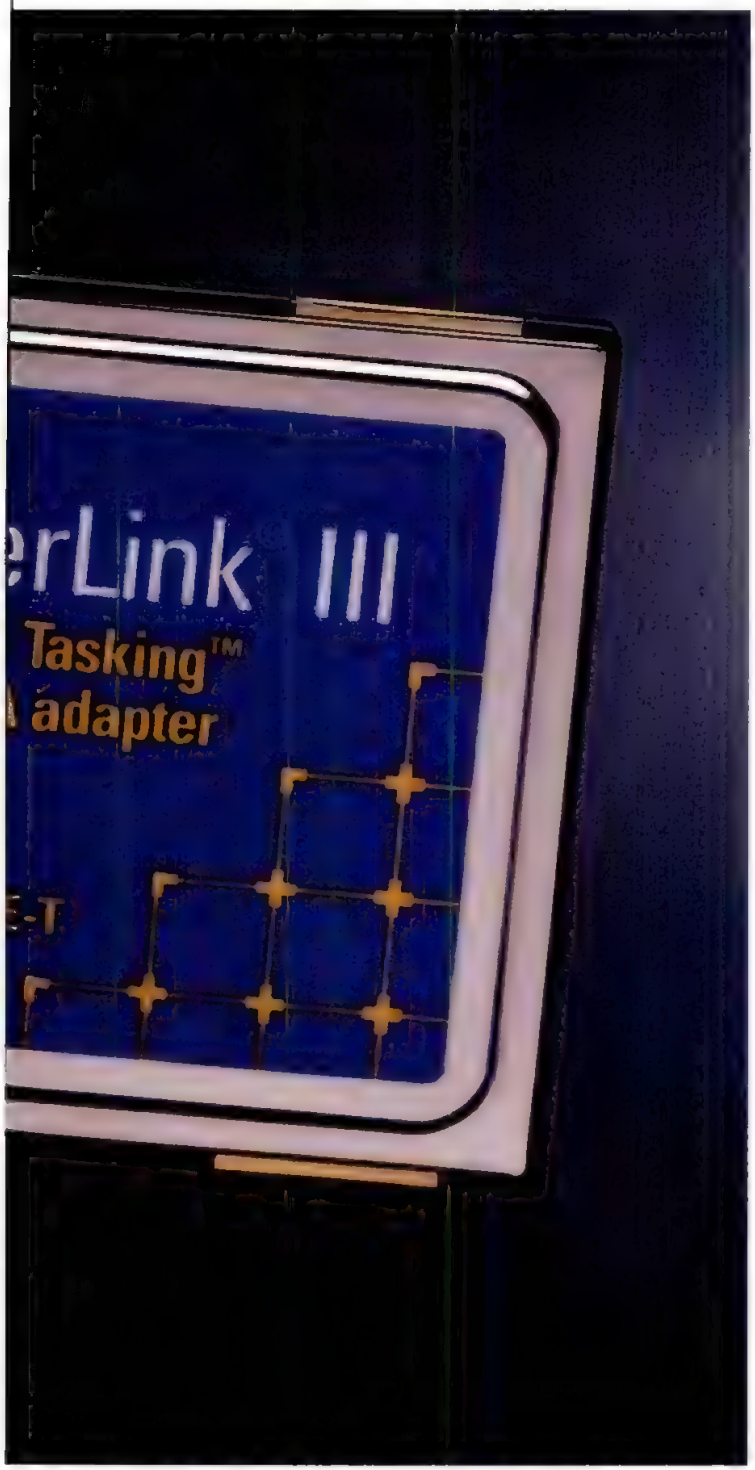
so fast, has lost weight.



The fastest Ethernet PCMCIA adapter is about to go even faster — because now you can buy it for just $195* instead of $250.*

Better still, the EtherLink® III PCMCIA adapter is built with 3Com's exclusive Parallel Tasking™ technology, delivering performance that is 45 to 110 percent faster than any other notebook adapter, according to LANQuest Labs.®

Card Services makes it even better.

On top of that, the EtherLink III PCMCIA adapter now includes Card Services support including unmatched "Hot Swap" capabilities, making it even easier to use.

And that's not just our opinion. LANQuest Labs said: "The 3Com card can be Hot Swapped in the middle of network activities without losing its network connection. It can even be Hot Swapped into a different PCMCIA slot. The leading competitor's PCMCIA card could do neither of these tasks."

Plus, with 3Com's AutoLink,™ you can install the EtherLink III PCMCIA adapter in under three minutes, with one easy step. Make a single menu selection to install the adapter, configure the drivers, and even download NetWare® client files from the server.

What's more, the EtherLink III PCMCIA adapter is compatible with all the leading notebook computers. Guaranteed. Or your money back. You even get a lifetime warranty.

So what are you waiting for? Get an evaluation card for as little as $99† and your free copy of the LANQuest Lab's PCMCIA benchmark reports by calling **1-800-NET-3Com**. But hurry. At these prices you can expect the EtherLink III PCMCIA to go even faster.

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Networks That Go the Distance™

CIRCLE 376 ON READER SERVICE CARD

* Estimated street price. †Limit one per customer, while quantities last. TP version $99. Combo version $129.

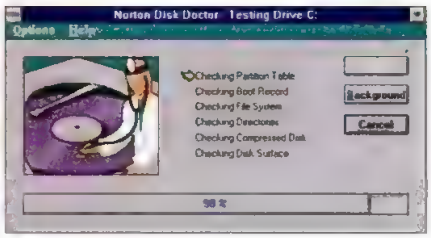
After Years Of Saving DOS Users, Now You Can Make The World Safe For Windows, Too.

If you've ever owned a copy of Norton Utilities®, you know you don't need a super-hero's cape to have magic-like powers.

Famous for its daring rescues and recoveries, Norton Utilities is one of the most honored software programs in the history of personal computing. And now there's new Norton Utilities 8.0.

The first software package to combine true Windows recovery and configuration management with proven DOS protection and recovery tools.

Whether you or someone you know is having hardware problems, file system problems, DOS or Windows OS problems, Norton Utilities 8.0 gives you all the tools you need for diagnostics and repair in one great package.

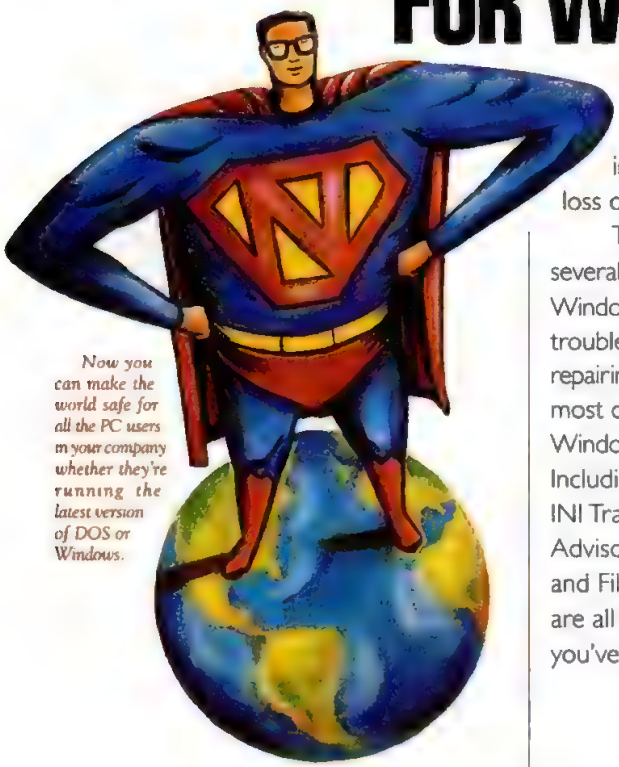


Like Speed Disk, Norton Disk Doctor runs in the background.

Our new System Watch monitors virtually everything going on within your Windows environment. What's more, it provides real-time crash protection by alerting you to any potentially dangerous situations that could result in system failure and the loss of your data.

There are still several other new Windows utilities for trouble-shooting and repairing even the most challenging of Windows problems. Including INI Tuner, INI Tracker, INI Advisor, INI Editor and File Compare. And there are all the classic DOS utilities you've come to rely upon.

The pioneer of data protection and recovery brings you the new improved Norton Utilities 8.0.



Now you can make the world safe for all the PC users in your company whether they're running the latest version of DOS or Windows.

A Monumental New Upgrade.

Both Speed Disk™ and Disk Doctor® now operate in the background. Providing continuous disk optimization and file system analysis and repair.

You'll find support for the widest range of compression formats under both DOS and Windows. In addition, there's a complete diagnostic tool set for analyzing all of your computer's hardware components from drives to video.

There's also our new Interrupt Conflict testing to help eliminate conflicts and their subsequent lock-ups and to make it easier for you to install new devices on your system.

It all adds up to a major upgrade.

And if you are one of those MIS super-heroes, ask us about our new Norton Utilities Administrator.™

Both our new Norton Utilities Administrator and our Norton Utilities 8.0 come with a full 60-day, money-back guarantee.

For more purchasing information, call us at 1-800-628-4777, ext. 9121.*

Start Your Day With Norton Utilities 8.0.

For maximum protection, you should always boot your PC with Norton Utilities 8.0 at the very beginning of your working day. So zap over to your local computer retailer or software store now. And make the world a safer place for everyone.

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CIRCLE 334 ON READER SERVICE CARD

Socket to Me

Intel prepares a smorgasbord of upgrade options.

To upgrade or not to upgrade? According to Intel, virtually all 486 systems can be upgraded. What Intel doesn't say is that virtually anyone can get mired in a confusing array of options Intel's OverDrive strategy targets the vacant sockets that manufacturers started building into PCs about two years ago.

For a time, it seemed as if Intel had lost the road map to upgradability by confusing us with numerous upgrade sockets of various sizes. The vacant socket in your PC may accept only those upgrade chips with a certain number of pins: 169, 237, 238, or 273 pins. If that's not confusing enough, soon there will be two more variations: 235-pin and 320-pin sockets.

PC manufacturers were confused, too, so Intel began a certification program that assures customers their PCs will accept Pentium-based OverDrive chips. PC manufacturers can send systems to Intel's Verification Labs where the systems are tested for minimum electrical and physical standards for the Pentium-based OverDrive. Systems that meet the standards will carry the "Intel Verified" logo.

By the end of 1994, there will be four types of OverDrive chips: SX2, DX2, DX4 (all of which are 486-based), and the Pentium, which is code-named P24T. Following Intel's recommendations, many PC makers placed a 238-pin ZIF (zero insertion force) socket on the motherboard. This socket will handle just about any OverDrive including the P24T.

The new DX4 chips powering the PCs evaluated in this issue's cover story, "The Pinnacle of Power," are based on a 0.6-micron 3-volt design, which means you can't casually drop one into an existing 5-volt DX2 system. Fortunately, the upcoming DX4 version of Intel's OverDrive upgrade chip will have an on-board voltage regulator that works in older 5-volt systems. And if you think that's high-tech, wait until you see the Pentium-based OverDrive that will have a built-in fan. —*Christopher Barr*

OverDrive Upgrade Shopping Guide

Which chip works in your PC? The possibilities seem endless, so we've prepared this table as a guide. For information by fax on which OverDrive chip your system accepts, call Intel at 800-525-3019.

If you have a...	With a...	You can install an overdrive...	To upgrade from...	To...
486SX or 486DX	168-pin socket	SX2 or DX2*	20, 25, or 66 MHz	40, 50, or 66 MHz or faster
SX or DX	169-pin socket	SX2 or DX2*	20, 25, or 33 MHz	40, 50, or 66 MHz or faster
3- or 5-volt SX, DX, 486SX2, 486DX2, or 486DX4	237-pin socket	SX2, DX2,* or P24T	20, 25, 33, 50, or 75 MHz	40, 50, or 66 MHz or faster
5-volt SX, DX, SX2, or DX2	238-pin socket	SX2, DX2,* or P24T	20, 25, 33, or 66 MHz	40, 50, or 66 MHz or faster
3-volt DX4	235-pin socket	P24T	75 to 100 MHz	?? (not yet determined)
5-volt Pentium	273-pin socket	P24T	60 to 66 MHz	?? (not yet determined)
3-volt Pentium	320-pin socket	P24T	90 to 100 MHz	?? (not yet determined)

*A DX4 OverDrive chip is expected to ship in the third quarter of 1994

Planning a Pentium Upgrade?

Before buying a P24T Pentium upgrade chip, you should examine the price/performance issues of upgrading versus buying a new system. Since the first P24Ts will go into DX and DX2 systems that have 32-bit bus interfaces, you won't benefit from the Pentium's 64-bit bus. A new system will have not only the latest processor, but probably a second-level cache and faster memory chips to exploit the CPU's power, too.

In 1995, Intel plans to ship P24T upgrades for the original 5-volt Pentium chip and the newer 3-volt chips. The 273-pin socket will upgrade the 60-MHz and 66-MHz 5-volt Pentium systems, and the 320-pin socket is for 3-volt 90-MHz and 100-MHz Pentiums. Intel has not yet announced the clock speeds of the Pentium upgrade chip, but earlier this year Intel previewed speeds of up to 150 MHz.—*CB*

Pipeline *By Robin Raskin*

Have You Hugged an Editor Today?

Editors, accustomed to operating in a world where their job is to supply instant answers to people who need them, are getting a little skittish about the Information Superhighway. After all, it has the potential to render them obsolete. In a world where everyone with an on-line connection is a news reporter, where the next great novel can be instantaneously self-published, and where anyone who feels like it can recommend your next computer purchase (grin), editors everywhere fear for their very existence.

After having spoken with many editors, I sense more than a bit of paranoia, but also a certain strong sense of reaffirmation of purpose, as they discuss their roles on the Information Superhighway. Unanimously, they feel that the Information Superhighway demands editorial guidance.

On the other hand, traditional print magazines and newspapers will only survive if they can quickly learn to understand how the on-line world requires a different sort of editorial sensibility. On-line services need to cultivate communities, stimulate conversations, and provide a two-way link where the editor is also the facilitator of communications.

To that end, there's a kind of feeding frenzy going on in the traditional media, which will cause many different and discrete media, such as newspapers, magazines, and television networks, to see one another as competitors. Many of these players have begun to formulate plans for the electronic repackaging of their products (see "The Electronic Newsstand" below).

Time Online includes material that would otherwise fall on the cutting-room floor. U.S. News Online, the electronic adjunct to *U.S. News & World Report,* offers the full text of the magazine, a lively dialog with readers, and some terrific supplemental materials, such as a large collection of documents on health care.

NBC News is currently planning its simultaneous on-line presence on AOL, GEnie, and Prodigy. Digital Ink, which is the electronic information subsidiary of The Washington Post Co., recently signed with Ziff-Davis Interactive's highly graphical Interchange to serve as its platform to house a package of information and advertising that is aimed at the Washington market.

The Atlantic Monthly already has a strong presence on AOL, in part because of strong editorial content supplied by journalists including James Fallows. Cox Publications launched Access Atlanta, a regional service on Prodigy. *The San Jose Mercury News*'s Mercury Center on AOL offers a community dialog and additional depth to its newspaper coverage. CNN and the Associated Press are hinting at launching an on-line video service, and Knight-Ridder's ambitious Information Design Laboratory has a prototype for an electronic newspaper that would be downloaded via cable or satellite to PCMCIA memory cards.

That's not to say that there's no room for new editors on the Superhighway. Starwave, a company owned by Microsoft cofounder Paul Allen, is positioning itself as an electronic publisher. Starwave's first on-line product on ZDI's Interchange will feature a sports information and statistics service. There's no doubt that editors will be on the Information Superhighway in full force. I believe that you'll be glad to see them.

Robin Raskin is editor of PC Magazine.

The Electronic Newsstand Sampler

Computer publications are no longer the only on-line act in town. Local newspapers, TV networks, and weekly newsmagazines are coming on-line. Most of these services supplement the printed editions with extra stories, messaging and editorial forums, classified ads, and community information. Many services now offer or plan to offer Internet access.—Melissa J. Peronson

On-line service	Where to go	Distinctive features
Access Atlanta	Prodigy, standalone	From the Atlanta Journal and Constitution; local news and calendar, on-line shopping.
Atlantic Monthly Online	America Online, standalone	Live conferences with writers.
CBS Hub	Prodigy	Programming information, forums with executives and actors.
Chicago Online	America Online	From The Chicago Tribune; local sports and leisure listings, TicketMaster access.
CNN Newsroom	America Online	From the Cable News Network; news in conjunction with cable-in-schools program.
ESPNET	Prodigy	Sports news and ESPN programming updates.
French Press Review	Internet (Gopher or e-mail)	French-language news from wire services and the French Ministry of Foreign Affairs.
The Gate*	Standalone	From the San Francisco Chronicle-Examiner; community information.
Mercury Center	America Online	From The San Jose Mercury News; San Francisco Bay Area leisure resources.
NBC	America Online, GEnie	NBC programming updates, publicity photos, messaging with executives.
New York Times Online*	America Online	Archive of arts and leisure reviews, cultural events information.
Newsday Direct*	Prodigy, standalone	Local content emphasis, forums for high school newspapers.
Orlando Sentinel Online*	America Online	Local news, leisure, TicketMaster access.
PostLink	Standalone	From the St. Louis Post-Dispatch; EAAsy Sabre, calendar, school lunch menus.
StarText	Standalone	From the Fort Worth Star-Telegram; EAAsy Sabre, Grolier's Encyclopedia, local news, events, and radio listings.
Time Online	America Online	A daily edition of Time, stories from the international edition, educational resources.
U.S. News Online	CompuServe	Photos and full text of U.S. News & World Report, editorial forums.
The Wall Street Journal*	Undetermined	Interactive Edition with database catering to the business community
Washington Post Extra*	Interchange, standalone	Conferences, additional features for families and sports buffs.

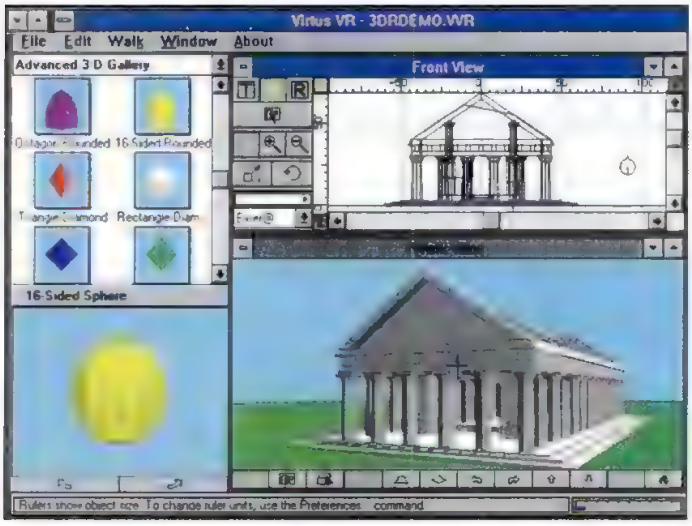
* Forthcoming service.

You can talk with writers on The Atlantic Monthly Online (top) and read in-depth news stories on Chicago Online (above).

3-D Windows

THREE-DIMENSIONAL GRAPHICS that appear to jump from your screen have been available on costly workstations for years, but Windows has sorely lacked high-quality 3-D graphical abilities. Microsoft even went so far as to license Silicon Graphics' OpenGL 3-D toolkit for the next release of Windows NT, which is code-named Daytona. There's hope yet for Windows 3.1 (and Chicago) applications with Intel's new 3DRender (3DR) technology. 3DR promises 3-D graphics, real-time animation, and photorealism for ordinary Windows applications.

3DR is not an application programming interface, but a foundation for developers to create 3-D tools. It's a rendering engine that applications can use to speed up the creation and manipulation of 3-D components under Windows. 3DR uses Microsoft's 3-D device driver interface and contains a dynamic link library that has 3-D primitives such as polygons, triangles, polylines, points, and lines that applications can use.



Virtus VR uses Intel's 3DR engine to speed photorealism and animation.

Developed at Intel Architecture Labs and code-named Intel Graphics Language, 3DR is open to all developers on a royalty-free basis. Intel has been working with graphics hardware manufacturers for a year to teach them about 3DR's *hook-out* mechanism, which lets hardware accelerate 3-D screens. 3DR doesn't require specialized hardware but does benefit from a graphics accelerator and can run up to 10 times as fast with a hardware assist, says Intel.

Among the graphics hardware vendors that support 3DR: ATI, Cirrus Logic, Diamond, Matrox, Media Vision, S3, Tseng Labs, Weitek, and Western Digital. The first boards with 3DR support should come out late this year.

Developers of games, scientific applications, CAD programs, and virtual reality apps will benefit from 3DR. It can also accelerate rendering and texture mapping of existing 3-D apps. What 3DR won't do is threaten high-end 3-D engines such as OpenGL or Hoops because it doesn't have its own geometry engine and can't do lighting and transformations.—*Christopher Barr*

High-IQ Batteries

QUICK. HOW MUCH JUICE IS LEFT IN your notebook right now? You probably have a fairly good idea when you'll need to recharge the battery, since most new notebooks today come with an on-screen power gauge. But thanks to grafting some intelligence into tomorrow's batteries, soon these gauges may be more accurate and may end up being cheaper as well.

Technically, the problem has already been solved. But the industry has not adopted a standard smart-battery specification. Thus, the consumer must pay for each company to reinvent the wheel.

Intel and Duracell, which entered the notebook battery market last fall with a line of standard-size batteries, have developed a bus architecture that enables a smart battery to communicate its status to a notebook. "The specifications are designed to let [notebook manufacturers] build systems that could use a smart battery," says Intel's David Ramey.

Duracell's smart battery contains a microprocessor that monitors current flow, calculates the battery's level of remaining power, and then communicates this information to the notebook. Intel Architecture Labs was key in developing two specifications that make this work. The Smart Battery Data protocol defines what kind of information is monitored (time remaining, temperature, and so on), and the System Management Bus specifies how the battery communicates this information to the notebook.

Duracell expects to introduce a battery this fall that will have an integrated display indicating remaining energy level. The nickel-hydride batteries are manufactured by Toshiba in Takasaki, Japan. Duracell says the battery smarts can be adapted to emerging technologies such as lithium-ion batteries.

Hoping to gain wide industry support, Intel and Duracell are now sharing the specs with notebook vendors. That may take some work. While on the surface there may be economies of scale in adopting a smart-battery standard, says Steve Andler, director of portable marketing at AST, it may not be advantageous in the long run. "The notebook industry moves so quickly that it may stunt innovation."—*Carol Levin*

Top Retail Software

Current ranking	Last issue	Product/ company
1	—	**MS-DOS 6.2 Upgrade** *Microsoft Corp.*
2	—	**MS FoxPro 2.6 for Windows** *Microsoft Corp.*
3	—	**MS Money 3.0 for Windows** *Microsoft Corp.*
4	6	**WordPerfect 6.0 for DOS** *WordPerfect Corp.*
5	—	**MS Windows 3.11** *Microsoft Corp.*
6	1	**MS Office for Windows 4.2 Upgrade** *Microsoft Corp.*
7	10	**Procomm Plus for Windows 1.02** *Datastorm Technologies*
8	4	**MS Windows for Workgroups 3.11** *Microsoft Corp.*
9	7	**Quattro Pro 5.0 for Windows** *Borland International*
10	2	**MS Office for Windows 4.2** *Microsoft Corp.*
11	9	**QEMM 7.0** *Quarterdeck Office Systems*
12	5	**Delrina WinFax Pro 4.0** *Delrina Technology*
13	—	**MS FoxPro 2.6 for Windows Upgrade** *Microsoft Corp.*
14	11	**Procomm Plus 2.01** *Datastorm Technologies*
15	—	**MS FoxPro 2.6 for DOS** *Microsoft Corp.*

This list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending April 23, 1994. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and cannot be interpreted as a picture of the entire software market. Sales information adapted from a compilation by Ingram Micro.

Switching Hubs Free More Network Bandwidth . . . Today

THESE DAYS, PLANNING A NETwork is no easy task. The challenge is providing the bandwidth for data-intensive client/server applications while preserving the investment you've made in current Ethernet, and Token-Ring hardware, all while keeping one eye on the future. The *switching hub* is one solution that LAN managers are beginning to adopt.

Bluntly put, 10 Mbps (Ethernet) and 4 or 16 Mbps (Token-Ring) just aren't fast enough for voice- or video-annotated e-mail over the LAN. More bandwidth is needed as more users join the LAN, companies downsize applications from mainframes to LAN servers, and faster RISC-based PCs demand their slice of the bandwidth.

Sooner or later, you'll need to upgrade or replace your network hardware if you make the move to 100-Mbps technology. Several high-speed technologies aimed at increasing bandwidth are here today. There's Fast Ethernet, FDDI, Full-Duplex Switched Ethernet, and 100Base-VG. Even faster Asynchronous Transfer Mode products are expected to ship in quantity next year (data transfer over ATM is scalable into gigabytes).

If the thought of changing adapters in every machine on your network inspires fear, consider that by using switching hubs you can gain bandwidth without opening the machines. You'll increase your network's overall performance while preserving current adapters and cabling on the client side.

Switching hubs perform *microsegmentation* of the LAN: They divide a LAN into multiple, smaller, independent segments and interconnect them at full network speed. This allows for fewer devices on a segment, increasing data-transfer speed. Think of the workgroups in your company now: accounting, human resources, production, and so on. Each is made up of a number of workstations, printers, modems, and fax servers.

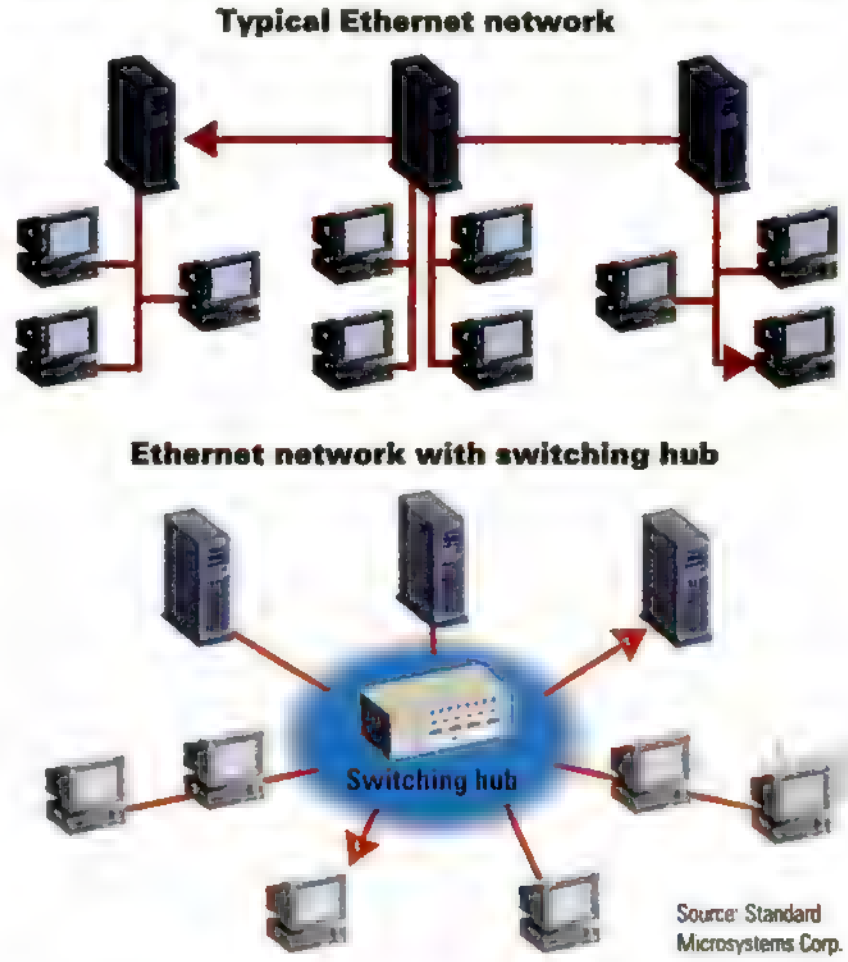
Depending on the size, each department could be broken into segments of ten workstations. When worker A launches a FoxPro database query, the switching hub is smart enough to know that worker A requires more bandwidth than others on that segment. For that period of time, the switching hub dynamically allocates bandwidth. Splitting the LAN into subworkgroups (microsegmentation) allows data traffic to be directed anywhere on the network without burdening other PCs.

Think "virtual workgroup" within an enterprise and you begin to get the picture. If you need to move a large amount of data, say, a few 20MB TIFF images, you won't have to worry about hogging bandwidth others need to get their work done thanks to the switching hub's ability to create a 10-Mbps data pipeline when you transfer those large files. Companies that offer Ethernet switching products include Alantec, Cabletron Systems, Chipcom, Grand Junction Networks, Kalpana, Lannet Data Communications, NBase Switch Communications, Network Peripherals, Standard Microsystems, SynOptics Communications, and 3Com Corp.

There's another compelling reason for you to consider purchasing Ethernet switching hubs. Most of the companies that are in this market see switching hubs as a viable migration path to ATM hardware.
—*Brendon Macaraeg*

Virtual Workgroups Deliver Speed

In a typical network configuration, data packets make multiple hops between servers, all PCs share bandwidth, and traffic slows down. A switching hub allocates full bandwidth (10 megabits per second) to a small group of PCs, and each PC has a direct connection to all servers for improved client/server performance.



Briefs

WIRELESS WARRIORS IN WASHINGTON, Baltimore, and Pittsburgh can now send messages over Airbridge Packet, a cellular digital packet data (CDPD) network that transmits data over the existing cellular infrastructure. The upcoming PocketPlus modem from Sierra Wireless and ThinkPad Mobile Communications Module from IBM will support the CDPD network. Next year, McCaw Cellular plans to deploy CDPD service in Dallas, Las vegas, Miami, New York, San Francisco, and Seattle.

FORTUNE 1000 COMPANIES HIT OBSTACLES in deploying remote and wireless messaging services. In a recent survey by research firm International Data Corp., companies expressed reluctance to adopt a companywide mobile computing plan for fear that investments would quickly become obsolete. By seeding mobile applications on a departmental basis, companies can adapt better to the rapidly evolving technology. Of those companies surveyed, 11 percent had already implemented wireless messaging services; 16 percent plan to implement wireless technology in the next two years.

PRESIDENT CLINTON HAS PLEDGED TO jump-start the flat-panel–display industry in the U.S. by awarding $500 million in research grants to American manufacturers over the next five years. The Pentagon's Advanced Research Projects Agency, which uses flat-panel–display technology in aircraft instrumentation, will disburse the funds. Today, Japan dominates the $5 billion industry. The plan requires congressional approval and may spark a debate on U.S. industrial policy.—*Carol Levin*

Music To Your Eyes.

The ZEOS® ColorNote™... scaling new heights.

With color and power you can't beat, the ZEOS ColorNote 486 is the only color notebook worth taking note! Now that we've scaled back prices by as much as $200, you'll never find a better value.

Just look what we give you: a reliable 486SX Intel processor running at 33MHz with 8K built-in cache; enough memory and power to run Windows; 4MB or 8MB RAM (expandable to 20MB); an 80MB, 120MB or 170MB IDE hard drive. And, we added local bus video for super-fast video performance. Blazing colors seem to sing. Images are vibrant and alive. For a crisp VGA backlit screen displaying up to 256 colors, the ColorNote employs dual scan technology–a breakthrough that achieves color comparable to that of a desktop color monitor yet is not as expensive as active matrix.

intel inside

ZEOS dual scan screen (left) fires up rich, vibrant colors while standard passive matrix screen (right) produces faded and dull colors. Photos are not retouched.

What's more, it comes equipped with a PCMCIA slot, an internal floppy drive, built-in trackball and a Nickel-Metal Hydride battery. If your needs go beyond the standard scale, you can compose a personalized package with our many options. Let the ColorNote be the basis for your creative scores and presentations.

AWARD-WINNING SERVICE

ZEOS has won more *PC Magazine* Readers' Choice for Service & Reliability awards than any other company–five in all!

We're here for you 24 hours a day, 365 days a year, and always a toll-free call away. All ZEOS systems come with a One Year Limited Warranty and 30-Day Money-Back Guarantee.

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ZEOS INTERNATIONAL, LTD.

STANDARD WITH EVERY ZEOS COLORNOTE 486

- 33MHz 486SX Intel processor.
- RAM expandable to 20MB.
- IDE hard drive expandable to 170MB.
- 8K internal cache.
- Internal 3.5" 1.44MB floppy disk drive.
- PCMCIA slot supporting a type I, II or III device.
- 512K video RAM.
- Local bus video for super-fast video performance.
- Display: 640 x 480 dual scan color VGA backlit LCD, 9.4" diagonal, up to 256 colors.
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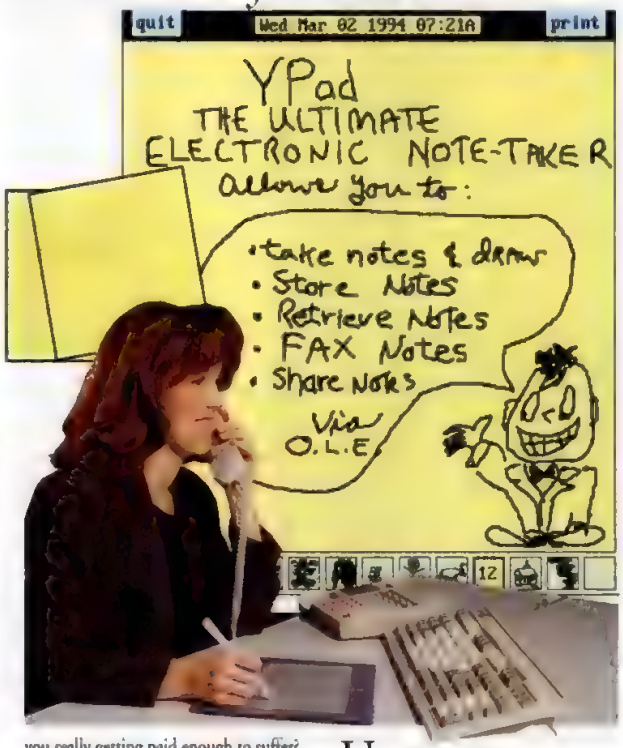

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Gestures are special pen strokes that perform specific editing functions, such as the cut gesture for deleting selected text.

Gestures are special pen strokes that perform specific editing functions,

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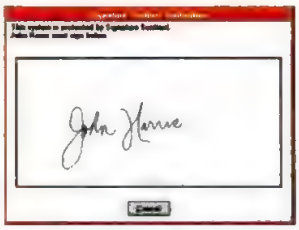

Why try to remember all those different passwords — and changing them periodically — when Handwriter for Windows comes with signature-verification security built into a screen saver? People may *try* to trace your signature, but it's virtually impossible for them to duplicate the stroke dynamics you used to write it. Signature-verification security makes a Handwriter the ultimate complement to your keyboard, especially in environments where many people have potential access to work areas.

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March 1994, PC Computing

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TRBA

First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

■ **Personal Finance**

MECA's Managing Your Money Breaks into the Windows Market

BY GREGG KEIZER

Nothing is tougher than playing catch-up in a software market as competitive as the one for personal finance. Breaking into a category so dominated by one package is rough enough; matching the leader feature for feature is nearly impossible the first time out the gate.

MECA Software seemingly has an edge in this come-from-behind run at the Windows personal finance business because of its highly regarded DOS-based Managing Your Money 10.0 (a *PC Magazine* Editors' Choice recipient, January 25, 1994). With the introduction of its $79.95 Managing Your Money for Windows 1994 Edition, MECA tries to leverage that reputation and move up the graphical money-manager food chain. Unfortunately, it stumbles rather than soars.

REAL LIFE: *In SmartDesk, a toolbar that depicts a home office, a click on any object calls up part of the program.*

While Managing Your Money for Windows is as capable as any Windows personal finance program in handling the basics—its financial advice and tax estimation skills are superb, and it even integrates banking, planning, investment, and tax management—it can match neither the prowess of its DOS ancestor nor the overall flexibility, feature set, and ease of use of Quicken for Windows.

BEGINNERS FRIEND

Managing Your Money gets you started by asking you to choose a home, business, or combined category list. It then directs you to create an account. Building additional accounts is usually simple, and the program walks you through the complex process of linking a mortgage account with your checkbook. You can import data from a variety of other packages, though not everything arrives intact.

By combining the check and register in a single window to better mimic a paper checkbook,

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■ **A Space-Solving, All-in-One Solution**

QMS Knowledge System Prints, Scans, Faxes

BY ALFRED POOR

In Arthur C. Clarke's masterpiece, *2001: A Space Odyssey,* mankind launched a search for a modern holy grail, a technological monolith somewhere in space. In the PC market, users have been searching for a different prize: a single peripheral to handle all imaging and printing needs. It's somehow appropriate that a new system from QMS should carry a 2001 reference in its name. This futuristic product has strong appeal, and it comes at a price that doesn't require a NASA-like budge.

The QMS 2001 Knowledge System PC is a *hydra*: a single unit that combines incoming and outgoing faxing, scanning, printing, and copying functions. The basic model works as a peripheral, but we tested a more elaborate version that also includes a built-in 33-MHz 486SX PC (the CPU is on an expansion card) with 4MB RAM, a 200MB hard disk, one floppy disk, a keyboard and mouse, a 14-inch monitor, and DOS and Windows.

HYDRA HEAD: *The $4,999 version includes a built-in PC and a monitor (not shown).*

A PRINTER AT HEART

Though we've seen a few other hydra devices before—most notably Okidata's DOC-IT (First Looks, February 23, 1993)—the Knowledge System

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IN FIRST LOOKS

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Photography by Thom O'Connor

MYM Windows

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the Managing Your Money for Windows' interface improves upon the same check metaphor popularized by Quicken. A toolbar at the top displays commands; you enter most transactions in form-based windows that look like checks or deposit slips. You can keep multiple windows open simultaneously.

An intriguing addition to the interface is SmartDesk, a navigational substitute for the toolbar. SmartDesk depicts a home office, complete with a desk and drawers. It lets you enter the program's primary areas by selecting various objects. Click on the checkbook atop the desk, for instance, and the check register appears. Although helpful for beginners, SmartDesk simply gets in the way once you're familiar with the program, so you can remove it whenever you want.

FIRST LOOKS PLUS

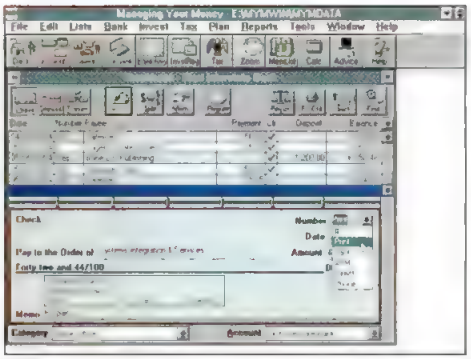
From June 20 through June 24, you can go on-line to download a self-running demo of Managing Your Money or to discuss the program with Gregg Keizer and MECA CEO Dan Schely. Type GO EXEC from any CompuServe ! prompt.

THE BASICS

Several automation techniques, now standard in personal finance software, speed up transaction entry. Managing Your Money completes a check as soon as it recognizes the first few letters of the payee, and it lets you memorize, then schedule, specific transactions for later posting. The program also reminds you of any pending work. However, scheduling is more cumbersome here than it is in Quicken, which offers a financial calendar into which you can drag and drop any transaction.

Managing Your Money lets you customize up to 20 reports, all of which can be memorized for recall later. A new Zoom feature assembles instant reports, but the program can't drill down to specific transactions for a close look at your data.

Other basic features—budget building and account reconciliation—work well but don't meet the standards set by the DOS version. For example, you can't see more than one category at a time as you assign budget values, and you can't create a budget by increasing or decreasing past amounts.

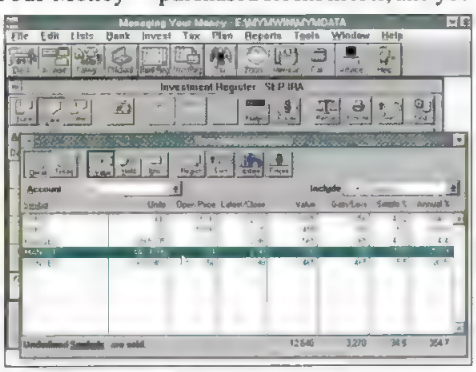


CHECKBOOK: *Managing Your Money puts both check and register in the same checkbook window.*

PORTFOLIO MANAGER

Much of the reputation of Managing Your Money for DOS stems from its portfolio-management and tax-planning abilities. The Windows version comes close to matching its predecessor in the former and equals it in the latter.

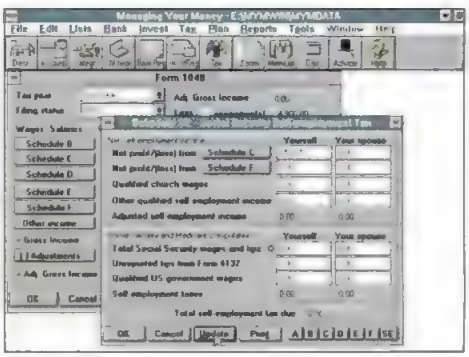
Managing Your Money's investment tracking is simple to use and provides the tools for almost any transaction. It tracks purchased stocks in lots, and you can sell short, reinvest dividends, and automatically move capital gains to the tax estimation part of the program. You can also set minimum and maximum reminder prices, so that the program notifies you when a stock hits a high or falls too low.



PORTFOLIO MANAGER: *Investment analysis is less than flexible since you can't modify the standard portfolio views.*

Unlike the DOS version, this program doesn't provide a means to update security prices by going on-line. More important, its analytical aptitude is less flexible than Quicken's; you can view the yield and value of the securities, but there's no quick indication of price fluctuations and no way to customize these views.

The program's tax-estimating power, however, remains outstanding. Several worksheets—including Form 1040 and Schedules A, B, C, D, E, F, and SE—help assess your tax liability. By linking various income and expense categories to these worksheets, you can get an instant picture of your tax situation at any time. You can also play "what if" games with the worksheets to account for future possibilities. Managing Your Money for Windows exports its data in .TXF format to tax preparation programs such as TaxCut and TurboTax.



TAX PLANNING: *Managing Your Money's tax estimators automatically pull numbers from your accounts to build an instant picture of your tax liability.*

Another area of expertise is in financial planning and advice. Thirteen financial calculators help you delve into mortgage refinancing, college savings, retirement planning, life insurance needs, and other issues.

What Managing Your Money really lacks is any link to electronic banking. Its DOS sibling and its Windows competitors all connect to a bill-paying service. Quicken and Microsoft Money, for example, offer links to electronic credit-card statements, and Microsoft Money, Simply Money, and Managing Your Money for DOS let you dial up for stock quotes. If you're planning on pursuing the money superhighway, Managing Your Money is not an on-ramp.

Managing Your Money for Windows is a creditable first effort. For the fundamentals of personal finances—writing and printing checks, balancing accounts, tracking expenses and income—it works as well as any package. For more advanced chores, particularly electronic banking, budget creation, and financial scheduling, it doesn't match either its DOS forebear or the premier Windows packages.

▶**Managing Your Money for Windows, 1994 Edition.** List price: *$79.95 ($29.95 to upgrade from Managing Your Money for DOS).* Requires: *4MB RAM, 8MB hard disk space, Microsoft Windows 3.1 or later.* MECA Software Inc., *55 Walls Dr., P.O. Box 912, Fairfield, CT 06430; 800-820-7458, 203-255-1441; fax, 800-944-6322.*

Circle 430 on reader service card

QMS

CONTINUED FROM PAGE 37

is the most capable one yet. At its heart is a 400-dpi, 6-page-per-minute laser printer that uses separate toner and photoconductive drum cartridges. It has a claimed 2,000 page-per-month duty cycle, and its engine has a sleep mode that reduces power consumption to below EPA Energy Star requirements.

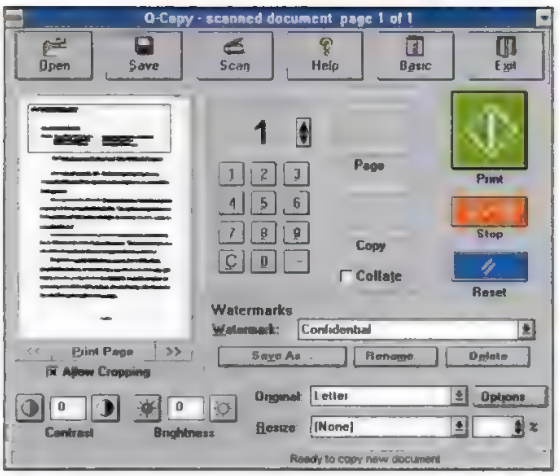
A monochrome scanner is built-in on top of the printer. The input tray can hold up to 20 sheets of paper, and the same tray doubles as the manual-feed tray for the printer. But the scanner does more than just scan. You can also use it to send faxes or to make copies. The original is scanned and then printed on paper fed from the 100-sheet-capacity printer paper cassette. Printed pages come out face down in a 50-sheet output tray.

To operate the unit as a copier, you use the front panel controls. It's easy to choose the number of copies, start the copy job, or clear the copy operation. There are no other controls on the unit; everything else is managed through software.

TOTAL CONTROL

The real power of the Knowledge System is in its Windows-based software. A single program, QMS Manager, provides control over all the unit's features. For example, copier controls let you specify the number of copies—just as with the front panel controls—but the software also lets you crop the image, specify changes in brightness or contrast, reduce or enlarge the image, and choose between draft (200-dpi scan) and quality (400-dpi scan) modes.

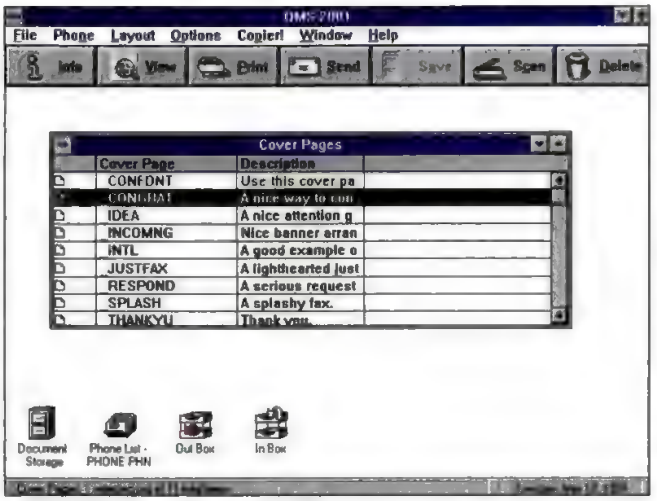
There's even a watermark feature that lets you print gray text across the page. The program comes with "Duplicate," "Urgent!," and "Confidential," but adding a custom watermark, such as a company logo, is no problem. Since the copying software scans the image to disk before printing, it is slower than using the front-panel copier feature, which sends the image directly to the printer as it is scanned. The software, however, gives you controls that are found only on high-end copiers.



SUPER DUPE: *You can make copies with software that offers everything from number of copies to cropping and watermark options.*

FAX MACHINE, TOO

You can print from any Windows application (QMS plans to provide support for DOS applications as well). A built-in fax modem (9,600 bps for fax and a very slow 2,400 bps for data) lets you send and receive faxes, and the software includes a collection of fax cover sheets. The fax system also supports binary file transfers with other Knowledge System units (or other systems running UltraFAX) and with CAS-compatible fax modems. You can send files either from the QMS Manager or by choosing the fax output as the printer from within any Windows application.



ALL TOGETHER: *The QMS 2001 Manager program gives you access to faxing, scanning, copying, and printing.*

Incoming faxes and scanned images reside on the computer's hard disk. These images can be turned into text with the built-in OCR (optical character recognition) software, and the results are stored either in a file or on the Windows Clipboard for immediate pasting into nearly any Windows application.

NEARLY SEAMLESS

The result is a nearly seamless integration of faxing, printing, and scanning functions. If you have information on paper or on-disk, you can do just about anything with it. Print quality is excellent at 400 dpi. Even though there is no resolution-enhancement feature, the output quality is noticeably better than it is at 300 dpi.

Based on its features, the Knowledge System is an ideal choice for small or home offices where a single user looking to save space needs ready access to most or all of the functions it provides. If you already have a computer, you can use the basic model system, which connects via a simple parallel cable.

Since QMS first announced the Knowledge System, it has made dramatic price reductions on the products. Originally, the basic model was priced at whopping $3,999 and the PC model was an even worse $6,999. After thinking it over, however, QMS wisely reconsidered. Now, the basic model is a more sensible $2,999, and the PC model carries a $4,999 price tag.

Both still represent sizeable investments for a small office, and that extra $2,000 is more than you'd expect to pay for a decent 486SX computer that you'd buy separately. If you already have a PC, the basic model cost is more reasonable—though it costs about the same as buying a separate laser printer, scanner, copy machine, and fax modem.

You pay no more, perhaps, for the convenience of having all these functions in a single unit, but some buyers might expect to see some cost savings from the integrated design.

Now that the price is within reach for many small office and home office installations, the QMS 2001 Knowledge System looks to be the first practical hydra for the PC market. If you've been searching the universe for a one-piece space-saving solution, your odyssey may be over.

▶ **QMS 2001 Knowledge System.** List price: *$3,999; PC model, $6,999. QMS Inc., One Magnum Pass, P.O. Box 81250, Mobile, AL 36689; 800-523-2696, 205-633-4300; fax, 205-634-0013.* *Circle 434 on reader service card*

■ Digitizing Tablets

Draw Conclusions About Tablets with Kurta's XGT

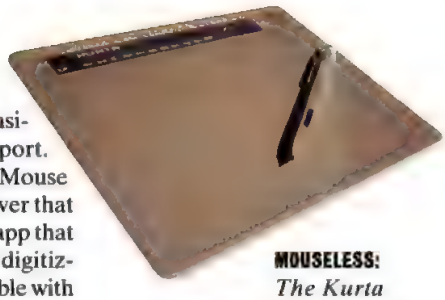
BY DON WILLMOTT

Digitizing tablets may never become mainstream computing peripherals, but as more users experiment with graphics on the PC, the usefulness of having a pen rather than a mouse as an input device becomes obvious.

Kurta's $399 XGT tablet is feature-rich enough to attract the attention of artists, but its small size—6 by 8 inches of active drawing area in an 8.5- by 11-inch package—makes it destined for the average desktop, too. With 256 levels of pressure sensitivity (when you push down harder you draw a thicker line), the XGT is twice as sensitive as its closest competitor, the $499 Wacom ArtZ (First Looks, February 8, 1994).

The XGT attached easily to our PC via a serial port. With built-in Microsoft Mouse drivers and a Wintab driver that works for any Windows app that can take advantage of a digitizing tablet, it was compatible with all the software we experimented with. What mouse users will notice first about using the XGT (or any tablet) is its concept of absolute positioning. Where the pen lands is where the cursor lands. You don't have to push the cursor around as you do with a mouse.

The XGT's cordless pen is somewhat chunky because it is battery-powered. So what's the advantage? You can use it up to almost an inch above the tablet, and that means you can trace drawings out of thick documents with little difficulty.



MOUSELESS: *The Kurta XGT has an active drawing area of 6 by 8 inches.*

Of course, pressure sensitivity is useful only in software that supports it, but users of Photoshop and CorelDRAW, two notable examples, are really missing out if they aren't taking advantage of the artistic advantages pressure sensitivity brings.

LIGHTER TOUCH

If digitizing tablets pique your interest but not to the tune of $399, you may want to get the version of Fractal Design Dabbler that includes the new version of Kurta's PenMouse, a $249 bundle. Dabbler, a beginner's drawing and painting program, is an excellent subset of the powerful Fractal Design Painter. The PenMouse, which is more of a mouse replacement than a high-end digitizer, has a 4- by 5-inch active drawing area that you can use simply for mouselike clicks or for drawing. The non-pressure-sensitive PenMouse is a good complement to a product such as Dabbler. It's an effective way to get the feel of working with a pen as an input device.

▶ **Kurta XGT.** List price: *$399.* Kurta Corp., *3007 E. Chambers, Phoenix, AZ 85040; 602-276-5533; fax, 602-276-9007.*
Circle 433 on reader service card

■ Fonts

Font Works Generates 152 Fonts on the Fly

BY EDWARD MENDELSON

ElseWare's $129.95 Font Works generates, substitutes, and manages fonts in a way unlike any other font package on the market. Instead of storing fonts on your disk in the form of outline files—the method used with standard Type and PostScript fonts—Font Works uses a technology that stores the data needed to build 152 separate fonts in a single data file, then generates each font when needed.

In fact, the only way you can even tell Font Works is present is by noticing all those additional fonts that show up on your applications' font menus.

FONT GROUPS: *The Font Works group menu lets you assign or remove fonts from applications' menus or organize them into groups.*

If you receive a document that uses fonts that aren't on your system, Font Works automatically substitutes its own fonts and always finds a much closer match than Windows can find on its own.

If the document uses any of 370 fonts found in the most popular retail font packs, the Font Works substitute will let the document have the same line endings on your system as it did on the system where it was created. You can also customize Font Works' selection of a replacement font for any specific font that you don't have on your system.

The program runs invisibly. You open the Font Works menu only when you want to change settings, find the details of font substitutions, or organize your fonts into groups that Font Works can move on or off your applications' menus. You also use the menu to access an ingenious type advisor program, with text by Daniel Will-Harris, that suggests specific Font Works fonts to suit the style you want in your document.

The 152 fonts in the package are copies of familiar designs, including the standard fonts in PostScript printers and in the HP LaserJet 4. Symbol and decorative fonts aren't included, because Font Works' technology builds characters from a database of common letterforms and doesn't support nonstandard characters or symbols.

The print quality of Font Works' fonts is astonishingly good, but the screen fonts are rough and unappealing. The best commercial fonts from Adobe and Microsoft look far better on-screen. The full Font Works package uses about 3.5MB of disk space instead of the almost 8MB needed for the equivalent TrueType fonts.

If you can live with Font Works' rough-and-ready screen fonts, the package gives you a large supply of typefaces in a small and technologically dazzling package. And if you often read documents created with fonts that are not on your system, Font Works' substitutions are the next best thing to the original.

▶ **Font Works 1.0.** List price: *$129.95.* Requires: *4MB RAM, 4MB disk space, Windows 3.1 or later.* ElseWare Corp., *101 Stewart St., #700, Seattle, WA 98101; 800-357-3927, 206-448-9600; fax, 206-448-7220.*
Circle 428 on reader service card

FIRST LOOKS PLUS

From June 13 through June 17, you can go on-line to download a trial version of Font Works or to discuss the program with Edward Mendelson and ElseWare cofounders Ben Bauermeister and Clyde McQueen. Type GO EXEC from any CompuServe ! prompt.

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CIRCLE 292 ON READER SERVICE CARD

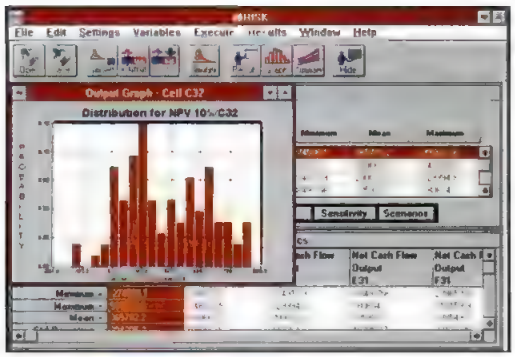
■ **Spreadsheet Utilities**

@Risk Takes the Risk Out of Guessing

BY CRAIG STINSON

@Risk, a $395 add-in for Microsoft Excel and Lotus 1-2-3, Release 4 for Windows, gives spreadsheet users tools for quantifying uncertainty. Like its competitor, Crystal Ball, @Risk lets you describe uncertain inputs in terms of their probability characteristics. Next year's potential interest rates or inflation, for example, might be described as having a normal distribution with a particular mean and standard deviation.

With the uncertainties so described, @Risk runs a simulation, using either Monte Carlo or Latin Hypercube sampling to plug random numbers into each uncertain input and recalculate the outputs at each iteration. @Risk then generates copious statistics and graphs that can be used to estimate the likelihood of particular outcomes.



A GOOD GUESS: *@Risk lets you create a scenario and project its outcome.*

The Excel and 1-2-3 versions of @Risk now share common command sets, toolbars, function libraries, macro verbs, and documentation. Both versions also use dynamic data exchange (DDE) to communicate with all output modules.

Sensitivity and scenario analyses are @Risk's most important new features. The sensitivity analysis uses a "tornado" graph to depict the impact of particular inputs on particular outputs. Armed with this information, you can focus attention on those factors that are most crucially related to success or failure and eliminate items that are of minimal importance.

The scenario feature identifies sets of inputs that are likely to cause a particular output to reach or exceed some user-defined target. You could use this, for example, to isolate which cost factors are responsible for generating overruns.

@Risk gives you the option of monitoring particular inputs for convergence during a simulation run. You can save time and feel more confident about the run by setting the simulation to halt when values are no longer changing significantly.

The principal difference between @Risk and Crystal Ball (apart from price: @Risk is about twice as expensive) is that uncertainties in @Risk are stated by means of custom worksheet functions rather than menu commands. This makes @Risk more versatile than Crystal Ball but also more difficult to learn and use. Those already knowledgeable about statistics and probability will appreciate the extra power of @Risk. Beginners, however, may not.

▶ **@Risk.** List price: *$395; upgrade, $149.* Requires: *4MB RAM, 4MB hard disk space, Microsoft Excel 4.0 or later or Lotus 1-2-3, Release 4 for Windows.* Palisade Corp., *31 Decker Rd., Newfield, NY 14867; 800-432-7475, 607-277-800; fax, 607-277-8001.*

Circle 427 on reader service card

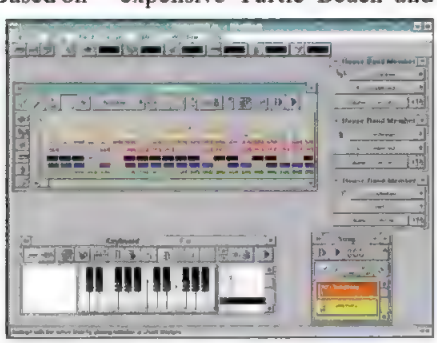
■ **Sound**

Ensoniq Soundscape Strikes The Right Chord

BY JOHN R. QUAIN

Known primarily for its synthesizers, instrument samplers, and electronic keyboards, Ensoniq Corp. is seeking to trade on its status in the MIDI world with the introduction of the company's first sound card. Based on our evaluation, Ensoniq Soundscape's, Version 1.0, should be well received. In ears-on tests, its audio fidelity sets a new standard in the under-$300, 16-bit class.

With a list price of $279 (and a street price of about $200), the Soundscape is aimed at improving MIDI support. The board has 2MB of 16-bit on-board wavetable samples and is capable of playing 32 simultaneous voices. Ensoniq uses its own wavetable design, which is more realistic than many others—although it's not up to the level of more expensive Turtle Beach and Kurzweil offerings.



TUNESMITH: *The Soundscape comes with SuperJAM! Jr. music-editing software.*

On the digital audio recording side, the Soundscape can record .WAV files at near-CD-quality levels (16-bit stereo at 44.1 kHz) or at less storage-hungry rates (8-bit mono at 44.1, 22.5, or 11.25 kHz). And to ensure compatibility, the Soundscape supports Sound Blaster–based games as well as AdLib, Roland MT-32 and MPU-401, and General MIDI standards. The system is even compatible with Microsoft Windows Sound System 2.0's software and microphone.

In recording tests, the Soundscape faithfully reproduced music and voice with little distortion. Ensoniq rates the board's frequency response at from 20 Hz to 20 kHz (+/- 1 dB), and we found no reason to doubt its appraisal. Recorded passages were also free of clicks and dropouts. Much of the credit for this goes to the Soundscape's 8-MHz Motorola 68EC000 processor, which alleviates strain on the CPU during recording.

Hardware support includes a MIDI/joystick port, a mono microphone/line input, a stereo CD/AUX input, and a stereo line output for speakers or headphones. There are three separate proprietary CD-ROM controllers to handle drives from Mitsumi, Panasonic/ Matsushita, and Sony. The only fault we found was that the board couldn't accommodate simultaneous audio inputs from an internal and an external CD-ROM drive. Nor does the software allow you to switch between the two.

All in all, however, the Soundscape sets a new standard in its price class.

▶ **Ensoniq Soundscape, Version 1.0.** List price: *$279.* Requires: *4MB RAM, 4MB hard disk space, Microsoft Windows 3.1 or later.* Ensoniq Corp., *155 Great Valley Pkwy., Malvern, PA 19355; 610-647-3930; fax, 610-647-3930.*

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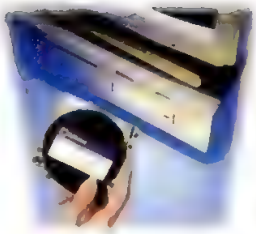

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CIRCLE 175 ON READER SERVICE CARD

■ Electronic Mail

FreeMail and Personal-E Mailbox: Basic E-Mail at Bargain Prices

BY NEIL J. RUBENKING

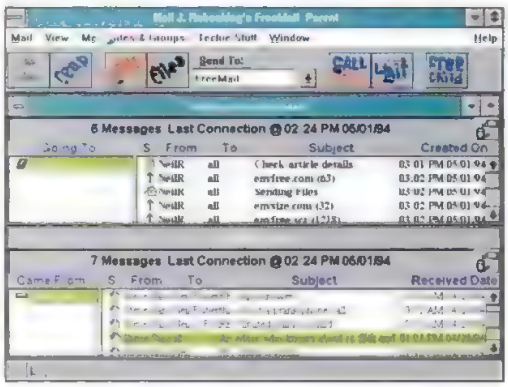
Most of us start using electronic mail for business and later discover that it can be very convenient for personal mail as well—as long as the recipient is a relatively hard-core computer user. Ask Uncle Joe the piano tuner for his e-mail address and you'll get a blank stare at best.

Saroff Design's $74.95 FreeMail (which bills itself as "the *pleasant* e-mail system for Windows") makes exchanging mail and files simple. If FreeMail's system requirements are too high-end for you, Personal-E Mailbox (PEM), $39.95 from AmerCom, runs under DOS on *any* PC, even runs from a floppy disk. Both of the products automatically seek out the modem and configure themselves to use the correct COM port.

FREE COPIES

To get your whole family or workgroup connected using FreeMail, you buy the product once and give away copies. Piracy, you say? No; it's legal if you follow the rules. The purchased copy of FreeMail is a "parent" copy that will create unlimited self-installing "child" copies. The child copies are automatically configured to call their parent, though they can communicate fully with any FreeMail parent. (Child-to-child communication is limited to 400-character messages and no file transfers.)

All Uncle Joe has to do is launch FreeMail, pick your name from the address list, and press the Call Now button. FreeMail will transmit all messages and files he's addressed to you. At the same time, it will pick up any pending mail that you've addressed to him. As a Windows app, FreeMail can sit in the background handling mail while you work with other programs.



FREEMAIL: *The next call that you make to FreeMail headquarters will send the files and messages in the Waiting to be Sent window.*

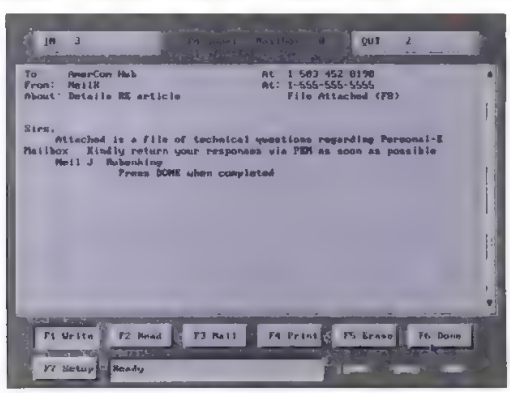
FreeMail demands Windows 3.1 or later on a 386 system or better, and in return offers some powerful features. It can poll other sites at specified time intervals, or even at particular times on certain days of the week. You can define restricted times when your FreeMail site won't answer the phone, and this information is updated at the recipient's end with every message. And you can create *groups* of sites (or even groups of groups) in your address book for mass mailings.

PERSONAL-E MAILBOX

You can't give away copies of DOS-based Personal-E Mailbox, but the price is reduced for twin and six packs and all PEM sites are full-featured. In RAM-resident mode, you can leave the program running without tying up the computer. Each call to another PEM site sends or receives precisely one message and any attached files. File transfer is somewhat awkward since you have to remember and type the full path name, and PEM uses an idiosyncratic DOS-based graphical user interface with no on-line help. But in truth, help is hardly required; the program is quite easy to use.

SMART RINGS

Both programs politely share a phone line with your answering machine or fax machine. No special switching hardware is required. As long as the other device can be told not to answer the phone before four rings, FreeMail's "logicAnswer" algorithm answers its own calls and no others. It dials twice using a particular pattern of rings and pauses that the receiving copy of FreeMail recognizes.



PERSONAL-E MAILBOX: *The software has an idiosyncratic DOS-based graphical user interface.*

PEM uses a somewhat different scheme: It picks up the phone even after a human or an answering machine has tried to answer. Either program can be set to answer on the first ring if a dedicated line is available.

Though they can't entirely replace a network or BBS system, FreeMail and PEM serve many of the same needs. Transferring files for free over the office phone lines is a lot more effective than toting stacks of floppy disks, for example. And these products are ideal for call-in messaging from remote sites or for implementing a company information center. FreeMail's persistent message feature is similar to bulletins on a BBS system and can automatically send a particular message to every caller or every first-time caller.

Sending a message this way is much faster than faxing it and can cost less than the price of a stamp. If your family or company needs e-mail access, give FreeMail or PEM a try. Both vendors offer a 30-day money-back satisfaction guarantee.

▶ **FreeMail, Version 3.11.** List price: *$74.95 for "parent" copy; unlimited free "child" copies.* Requires: *2MB RAM, 1.5MB hard disk space, Microsoft Windows 3.1 or later.* Saroff Design, *1901 Missoula Ave., Missoula, MT 59802; 406-542-3867.*
Circle 420 on reader service card

• **Personal-E Mailbox, Version 2.0.** List price: *$39.95.* Requires: *512K RAM, DOS 3.0 or later.* AmerCom Inc., *1100 NW Compton Dr., Beaverton, OR 97006; 800-239-8295, 503-531-2880; fax, 503-531-2884.*
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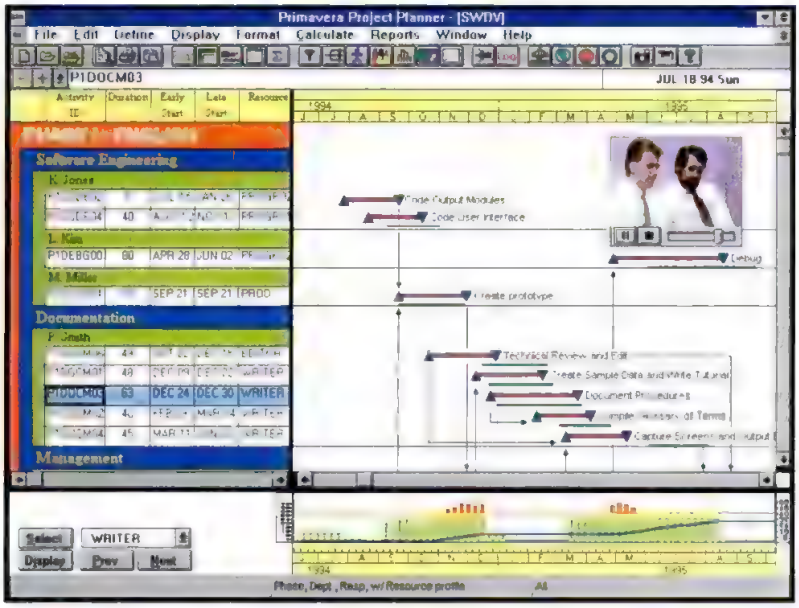

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■ **Electronic Mail**

The Wire 3.0: Speeding Up MCI Mail Access

BY DON WILLMOTT

Hundreds of thousands of MCI Mail users have spent years looking for the perfect mailbox for their e-mail. Swfte International's The Wire looked like it might be the answer, but the first two versions were slow and sometimes undependable.

The new $99.95 Version 3.0 erases most of those unhappy memories. By starting over with a new database system (it's Btrieve-based rather than Paradox-based), Swfte has made The Wire faster, and it's added common-sense features that should have been there all along.

The biggest improvement is that thanks to the new database structure, The Wire no longer needs to go through the process of formatting an incoming message before you can read it.

Version 3.0 has the new ability to add subfolders to the folders into which you sort your mail. Just about every other e-mail front end has these nested folders, so in this case, The Wire is playing catch-up. The program's support for 14.4-Kbps data transmission is also just in time; early, in fact, since MCI Mail doesn't officially support 14.4-Kbps transmission yet.

Users who don't like having to scroll through their address book to compose a message now have the option of sending a quick message just by typing Alt-F-N (File New). The message dialog box pops up, and you avoid the address book altogether.

The addition of a spell-checker is a nice touch for sloppy typists, and by accommodating up to four address books and letting you share address books in a workgroup, the program helps groups of people work together for the first time.

PLEASED POSTMAN: *Nested folders, new to The Wire, help you sort your mail.*

There's even one new feature that no one asked for: silly sound files that you can attach (optionally) to almost any activity in The Wire.

The speed improvement in Version 3.0 is reason enough to upgrade if you're already a user of The Wire. MCI Mail has never looked better.

▶ **The Wire, Version 3.0.** List price: *$99.95; upgrade, $15.* Requires: *2MB RAM, 2MB hard disk space, Microsoft Windows 3.1 or later.* Swfte International Ltd., *Stone Mill Office Park, 722 Yorklyn Rd., Hockessin, DE 19707; 800-237-9383, 302-234-1740; fax, 302-234-1766.*
Circle 436 on reader service card

■ **Communications/Sound**

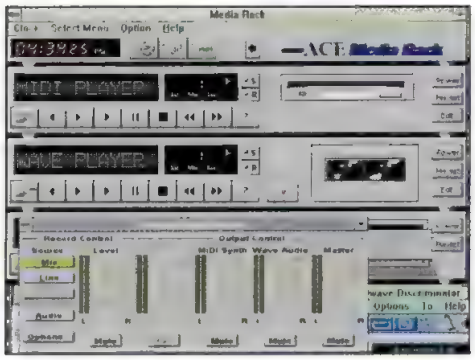
ACE Deals a Full Hand of Comm Tools

BY WINN L. ROSCH

This ACE has a DSP up its sleeve. Thanks to a digital signal processor, Best Data Products' $299 ACE card combines data and fax modems, an answering machine, voice mail, sound synthesis, digital recording, and CD-ROM control on one board. ACE differs from previous combo cards, however: Since all DSP functions are software-upgradeable, ACE's DSP promises excellent performance and immunity to obsolescence.

As an audio coprocessor, the DSP also prevents voice and sound processing from overloading your PC's microprocessor, which can cause dropped syllables or broken speech.

The ACE hardware is exemplary: a short (5-inch) ISA board loaded on both sides with surface-mount components, all built around a Texas Instruments DSP. Although Creative Labs Sound Blaster–compatible, ACE uses wavetable synthesis. The hardware has only two drawbacks: It's too tall for PCs that don't host full-height expansion boards, and the CD-ROM interface matches the proprietary Matsushita connection rather than the more common SCSI.



MUSIC MAKER: *ACE software includes utilities to play sound files.*

Bundled with ACE are several Windows apps, including QuickLink II for controlling the modem, answering machine, and mail system; a fax viewer; a .WAV file player; a talking alarm clock; TalkWorks, a digital audio recorder and editing system; a CD controller; Music Sculptor; and a discriminator to route incoming modem, fax, and voice calls.

Running the software requires a great deal of patience. Even with the help of technical support, it took us two days of trial and error to make the board work. In the future, snooping software will accompany the board to search out settings.

The clearly illustrated manual and installation procedure are not well integrated, and the otherwise state-of-the-art board uses jumper and DIP switch configurations. Just making a diagnostic disk proved to be a cumbersome, poorly conceived process.

When it worked, ACE worked well. Speech recording was crisp and clear without a trace of digital garble. Even modem tones came through unusually clearly and the modem tolerated a wide range of line conditions. But several software shortcomings appeared during evaluation. Hayes compatibility was incomplete (pulse and tone dialing can't be mixed); some sounds got lost because of mismatched muting; and the talking clock had worse pacing and inflection than a Catskills comic.

ACE is an impressive feat of hardware engineering, but it needs help on the software side before it can be a truly smooth operator.

▶ **ACE.** List price: *$299; MIDI option, $49.95.* Requires: *6MB RAM, 5MB hard disk space, Microsoft Windows 3.1 or later.* Best Data Products Inc., *21800 Nordhoff St., Chatsworth, CA; 818-773-9600; fax, 818-773-9619.*
Circle 405 on reader service card

■ Multimedia

MegaMotion Puts Four Video Images On-Screen...

BY WINN L. ROSCH

Seeing double doesn't mean trouble for Alpha Systems Labs' MegaMotion. This $995 multimedia video board can fill your Windows screen with not one, not two, but four video images (two with full motion), capturing and compressing NTSC or PAL composite or S-video sources to disk or sending them from your hard disk to a video monitor or to videotape.

It can rotate images 90 degrees, create scrolling titles, freeze frames, and do gamma correction. With the appropriate software, you can cut, wipe, or dissolve from one image to the next.

In fact, the only reason ASL doesn't put MegaMotion in the professional class is because its performance peters out just shy of full 640-by-480 resolution at 30 frames per second (fps). Its chips and interfaces constrain the board to 15 fps at full resolution or 320-by-240 resolution at full speed. That limit doesn't mean an empty screen; you can fill your 1,024-by-768 monitor by interpolating images or tile it with up to eight images in MegaMotion's four overlays.

OVERLAY ADVANTAGE

Overlays are video images that the MegaMotion creates by replacing (overlaying) a blank patch on the screen using linear, chroma, luminance, or Alpha-channel keying. (With its $100 SuperVGA option, MegaMotion handles the mixing as well as Windows image-making.)

Overlaying sidesteps most PC throughput bottlenecks, allowing the MegaMotion hardware not only to capture most images in real time using JPEG compression but also to store them in all standard PC video formats. Even so, you'll need a well-equipped PC to capture the entire onrushing video stream intact. ASL recommends that you use a separate hard disk for images (a SCSI-2 disk spinning at over 5200 rpm is best) to avoid Windows overhead. In testing, a 66-MHz 486DX2 system with a single SCSI-2 hard disk dropped dozens of frames during a few seconds of high-speed video capture.

Adobe Premiere 1.0, software for creating and editing video movies under Windows, is included with MegaMotion. Unfortunately, neither Premiere nor any other available software makes use of the simultaneous four-image abilities or many of the other advanced features of the MegaMotion, although ASL reports that programs are being developed for it.

▶ **MegaMotion.** List price: *$995; with accelerated SuperVGA circuitry and additional 1MB VGA frame buffer, $1,095.* Requires: *8MB RAM, Microsoft Windows 3.1 or later.* Alpha Systems Labs Inc., *2361 McGaw Ave., Irvine, CA 92714; 800-576-4275, 714-252-0117; fax, 714-252-0887.*
Circle 431 on reader service card

FOUR-IN-ONE: *Two of four simultaneous video views can be full-motion.*

■ Multimedia

...While 928Movie Shows Video Full-Screen

BY BRAD STILWELL

No desktop video solution today approaches true broadcast quality, but VideoLogic's $349 928Movie provides affordable full-screen PC movie viewing that comes as close as you can get today. Targeted primarily at home multimedia PC users, the 928Movie combines respectable Windows acceleration with full-screen 30 frame-per-second (fps) video at high resolutions and optional CD-quality sound.

We tested a 2MB VL-Bus version—with sound—that sells for $549, a price that some standard 2MB video boards based on the S3 928 chip claimed less than a year ago. Not only is the 928Movie among the fastest 928-based accelerators we've seen, it also scales up .AVI clips as small as 160 by 120 pixels and as fast as 30 fps to full-screen without losing any frames. On a Micron 66-MHz 486DX2 VL system with 8MB RAM, the 928Movie earned a high Graphics WinMark score of 12.2 million pixels per second at 800-by-600 resolution with 256 colors. At the same resolution, it scored 52.0 on the Winstone 94 test; a performance comparable to the best boards in its chip class.

Without the 928Movie's PowerPlay32 enabled, the board dropped nearly 70 percent of all the frames from a 320-by-240 15-fps clip in true color; with PowerPlay32 on, it didn't drop a single frame. When the playback window is stretched to full-screen, the 928Movie produces visibly pixelated (though passable) motion video.

The board supports Cinepak, Indeo, and Video 1 compressed files. Its VESA Media Channel (VMC) support makes multimedia add-on boards possible, as well as the use of video capture and MPEG-1 playback daughterboards. Some will be released this summer.

You can add basic sound capabilities to the 928Movie without taking up a second slot, a feature that sets it apart from most multimedia boards. An optional $100 Yamaha OPL3 FM-synthesis chip provides 16-bit audio for Creative Labs Sound Blaster or Ad Lib-compatible games.

The 928Movie will soon be challenged by what promise to be competitive, if not superior, color filtering and scaling solutions from S3 and Weitek, but its optional sound and VMC expandability should satisfy home PC users looking for a one-slot multimedia solution.

▶ **VideoLogic 928Movie.** List price: *With 1MB RAM, $349; with 2MB RAM, $449.* VideoLogic Inc., *245 First St., Cambridge, MA 02142; 800-578-5644, 617-494-0530; fax, 617-494-0534.*
Circle 432 on reader service card

■ On-Line Access

WinGopher: A Key to the Internet Kingdom

BY RICK AYRE

You've heard the complaint: The unmanaged Internet is such a vast labyrinth that it's sometimes impossible to find that one special piece of information you're looking for. True enough, and that's why savvy Internet users have long employed Gopher servers and the menus they present to jump from one Internet site to another. Gopher menus may not have the style that Mosaic and its World-Wide Web servers have, but they're the gatekeepers to a seemingly limitless wealth of information. Notis Systems' $69.95 WinGopher is a Windows user's key to that wealth.

SPECIAL AGENTS

A Gopher agent's assignment is to go out and find something: a library, a file, a database, or all three. Using Gopher servers, Internet sites organize the information they store in a hierarchical fashion and present menus that let users jump from place to place. There are over 1,400 Gopher servers offering everything from the full text of the NAFTA treaty to all the back issues of *Wired* magazine.

The Gopher protocol has been extended with links to search tools, like archie (which searches FTP indexes so that you can locate files to download) and Veronica (which searches Gopher menus for specific text strings).

By linking all of these tools, Gopher users can jump from site to site or search for files and text simply by choosing various menu options. When you start a search from a Gopher, the results are returned as a Gopher menu. The interface is simple and intuitive.

FAVORITE CLIENT

To access Gopher servers, you need a Gopher client such as WinGopher. As the first Windows-based Gopher client software, WinGopher reduces your searches to a series of point-and-click actions. It represents Gopher menu items with icons: Another Gopher menu is a file cabinet, a text file is a piece of paper, a binary file is a PC, and a search is an eye. Text next to each icon describes what it represents.

WinGopher uses a multiple document interface. Each window contains one Gopher menu, which it calls a collection; each collection can contain any combination of the items usually found on Gopher menus. Notis includes some starter collections that point to Gopher servers highlighting Internet resources, government Gophers, and much more. Creating your own collections is easy—you just choose New Collection from the File menu and then populate your collection via the Edit menu's New Item selection. The easiest way to add items is to jump to a Gopher you want to visit on a regular basis and then pick Add Item from the Edit menu.

WinGopher's big brother, the $129 WinGopher Complete, attacks the problem of getting connected to the Internet. In the box with it is a version of Distinct TCP/IP that works over properly configured PC networks; also included are SLIP and PPP for PCs that must use an asynchronous connection. WinGopher Complete even comes with scripts for connecting to the most popular public access providers via SLIP and an automated way to select the script best suited to your needs. All you have to do is call a provider, sign up for service, and select that provider's script from those provided by Notis.

THE KEY FITS

Can connecting to the Internet possibly be that easy? Yes and no. We installed WinGopher on a PC that was directly connected to the Internet (using Novix for NetWare), and it was a snap.

But when we tried to install WinGopher with Distinct TCP/IP in order to use a SLIP connection, we had nothing but problems. To be fair, the problems were not with WinGopher itself or any of the products supplied with it; still, our attempts to get it working were frustrating. Following the Notis instructions, we were able to get everything installed; we were also able to call up and connect to Notis's Gopher server. Unfortunately, however, every time we tried to make the software work, we were told that we could not be connected to the Gopher host.

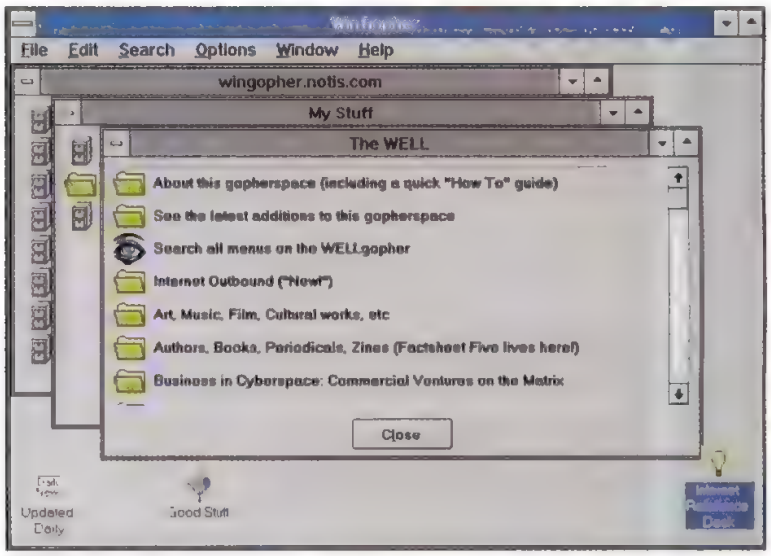
It turned out that the problem was with domain name server resolution. Because we had multiple versions of WINSOCK.DLL installed on our test system, WinGopher got confused and used the wrong one. Not a problem caused by Notis, but one that had to be resolved before we made SLIP connections successfully.

THE GATE'S OPEN

Once it was successfully connected, WinGopher was a joy to use. So much so that we were able to develop our own customized menu system and represent it with an icon of a black hole. By making Internet access so easy, WinGopher encourages exploration—and exploration on the Internet can be boundless. Be warned: WinGopher can make the Internet addictive beyond belief.

▶ **WinGopher.** List price: *$69.95.* **WinGopher Complete.** List price: *$129.* Requires: *2MB RAM, 4.5MB hard disk space, Microsoft Windows 3.1 or later.* Notis Systems Inc., *1007 Church St., Evanston, IL 60201; 800-556-6847, 708-866-0150; fax, 708-866-4970.*

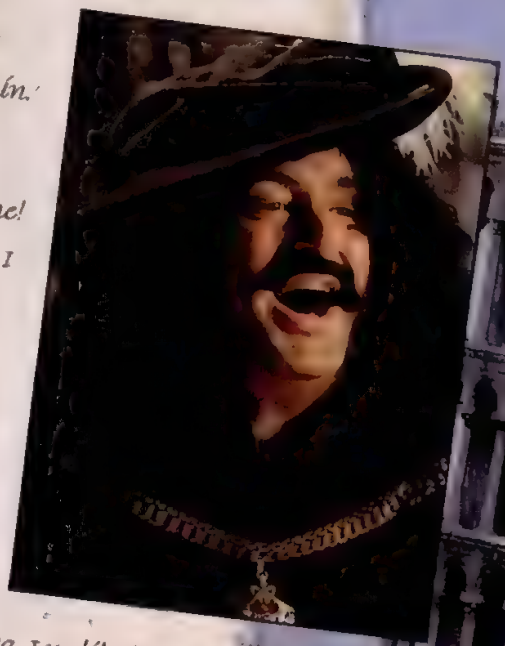
Circle 437 on reader service card



INTERNET SENSE: *WinGopher shows you the results of your Internet searches in clear, concise menus.*

"If I Only Had A Gateway!"

There I was, eating Mama's spaghetti, when Guido and the boys come over, 'Yo Bonanno! Your tower, it'sa leanin.'



Mama-mia! What'sa matta me! That'sa last time I buy a kit from the Towers-R-Us catalog. Never get enough cement mix. So, I used my mother-in-law's linguine sauce as extra cement. 'Oh boya, I no like how that turned out. And that'sa last time I tell the workers we eat only after the foundation is laid!

I guess they tried to tell me the soil was bad. I thought they said the 'royal' was bad. And they were right – that King Antonio waza pretty nasty.

If I had a Gateway P5-90, I coulda designed my own tower. And it woulda been magnifico! The best tower the world ever saw.

Looka me. I coulda done so much better. It'sa too late for me and my tower. Don't you be offa plumb, and be saying like me, 'Gee, I wish I woulda had a Gateway.'

"Gateway's Pentium Architecture Would've Set Me Straight"

...Bonanno Pisano, engineer, 1174

"If I only had a Gateway!" — the anguished, rueful cry of a non-Gateway user. The lesson: Don't leave the success of *your* landmark projects to an archaic system. Get a Gateway 2000® PC and you'll have the latest technology in a high-quality PC, built to stand the tests of time. You get straightforward service and support from Gateway's knowledgeable employees. And best of all ... no regrets coming back to haunt you!

Gateway's Superstructures

Look at it from this angle. You just gotta have the most powerful PC architecture available today, right? But there's no way you want to pay skyscraper prices, true? Your solution? Gateway 2000's P5 systems! These Pentium™-based machines are designed to give you all-around monumental performance — they're some of the fastest PCs you can find today! Capice?

Based on Intel®'s Pentium processor, all P5 models include a PCI local bus and an enhanced PCI/IDE controller allowing your hard drive to transfer data *up to twice as fast* as non-enhanced IDE systems. Gateway's P5-60 and P5-66 models, and our three power-packed **90MHz** models (*starting at just $2,995*), give you a value that towers over the competition!

Gateway's P5-90 machines use Intel's super 90MHz processor for foundation-shaking power. You get a rare combination of colossal power and performance, *and* a great price. Ah, magnifico! Just look at these features: performance-boosting 540MB hard drives, 8MB or 16MB RAM, double-speed CD-ROMs, high-end graphics controllers and your choice of application software. Two 90MHz systems also include 16-bit sound cards and Yamaha speakers. Go ahead and compare. You'll see that these value-packed PCs stand unmatched.

Get all the tools to create lasting impressions with any Gateway P5 system. Mama mia — starting from only $2,495, our Pentium values are out of this world!

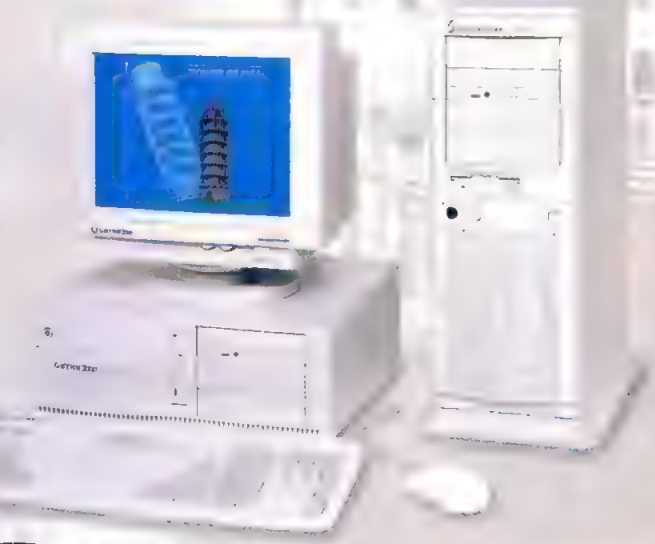
Classic Attractions

Our 486 PCI machines are Gateway 2000 classics built on a solid foundation of performance and value. Our new **100MHz DX4** machine, priced at $2,495, is based on the fastest 486 processor available! With the same PCI local bus as in our P5 line, all 486 PCIs will give you a great power boost. They include 8MB RAM, 540MB hard drive and a double-speed CD-ROM drive. These 33MHz, 66MHz and 100MHz systems are all upgradable to Pentium technology so you can expand in the future.

Portable Sidekick
Special Offer!

A perfect sidekick for your Gateway desktop system is the HandBook® 486 portable PC. It's just like having an extension to your desktop system! Call about our special desktop/HandBook combo today, available only at the time of desktop purchase. Having all the information you rely on, everywhere you go, has never been so easy.

Gateway's P5-90 and P5-90 Tower systems rise above the competition!



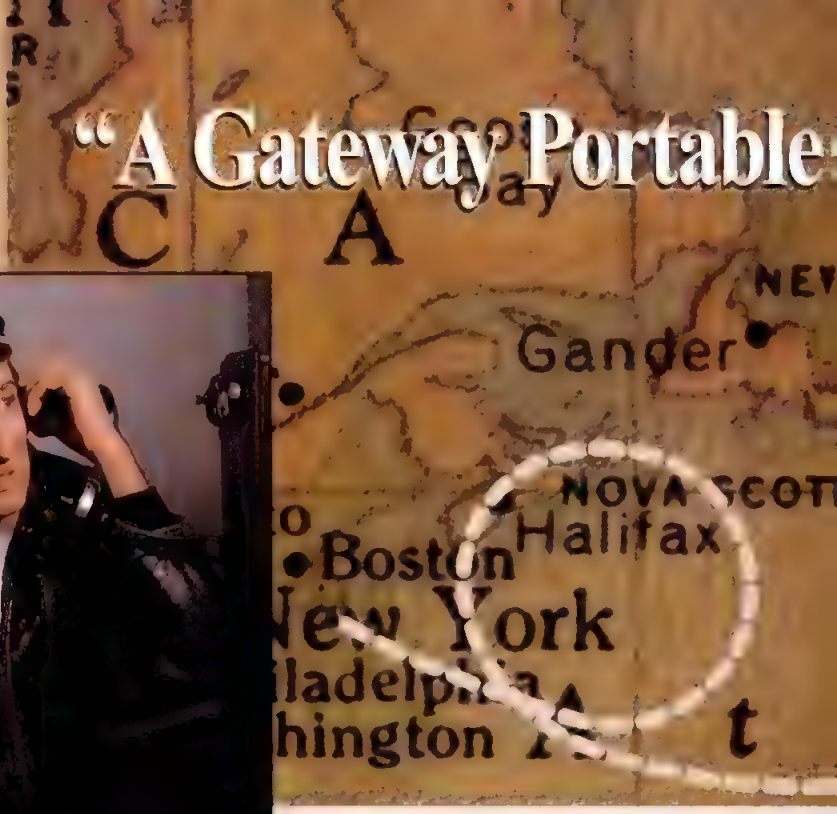
intel inside pentium PROCESSOR

GATEWAY2000

"You've got a friend in the business."®

800-846-2063

"A Gateway Portable



Heading out on another worldly expedition? Whether it's transcontinental or transatlantic, a Gateway portable PC puts you at the controls, steers you in the right direction and sends you flying!

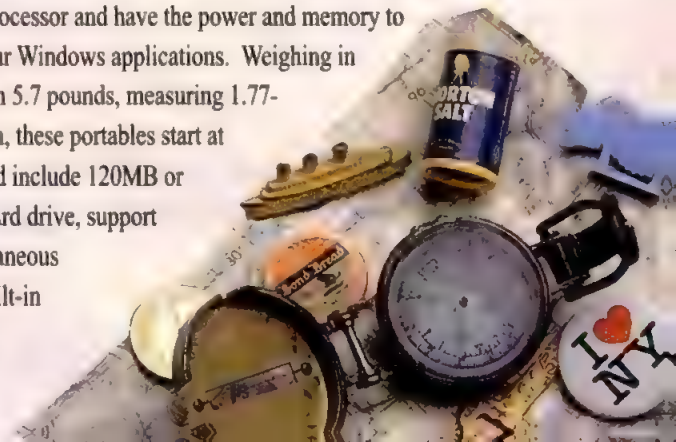
GATEWAY2000
COLORBOOK™

Flying Machines

How can you go wrong? You can't! A Gateway 2000® ColorBook is just what you need for high-in-the-sky performance.

A portable PC with the supersonic performance of a desktop is yours with the power-packed **DX4-75MHz** ColorBook. With a 75MHz processor, you'll never want to leave the ground without it. And look, over there! No, your eyes aren't deceiving you — that's a **10.3-inch, dual-scan screen**, now on *three* ColorBook models. You won't find a screen this big, this affordable, anywhere else. It blows the competition out of the water!

All ColorBook models are based on the Intel® SL Enhanced 486 DX2 or DX4 processor and have the power and memory to run all your Windows applications. Weighing in at less than 5.7 pounds, measuring 1.77-inches thin, these portables start at $1,995 and include 120MB or 250MB hard drive, support for simultaneous video, built-in trackball,



Do you know the way to San Jose? New York 1938. I readied my $900 airplane for the flight to California. Everyone has a hobby, right? Little did I know my obsession with refrigerator magnets would bring a dark cloud of humility down upon me.

I placed my collection of magnets all around me. Mr. Piggy on the throttle, the Morton Salt ad by the altimeter and my favorite, the Titanic, right by the compass — hundreds of magnets all over the cramped cockpit.

As I took off into the wild blue yonder, did I hear someone say, 'Hey, Douglas, you're going the wrong way!' No, they must've said, 'Have a nice day.' I'd been flying awhile when I looked down and thought - I know they're called the Great Lakes, but this is ridiculous! Is this compass right? I whacked it a few times, some of my dashboard magnets fell on the floor. My compass went crazy until I put them back in place. Go figure. I continued on. Hey! What was that? A whale in Lake Superior?

Land greeted me after 27 hours. Where's the sun, the beaches? I only see redheads and Lucky Charms?

Damn those refrigerator magnets! Boy was the wife steamed, 'Hello, honey? Um... I'll be a little late for dinner.' I wish I would've had a Gateway portable to keep me on course.

Would've Steered Me The Right Way"

began flying eastward out over the Atlantic Ocean. After 27 hours he landed

two PCMCIA Type II or one Type III slots, 256 colors running in VGA mode, excellent battery life, and a great suspend/resume feature.

You'll know you're headed in the right direction for top-flight performance when you get a Gateway ColorBook.

GATEWAY2000 HANDBOOK® 486

Take Flight!

It's so lightweight, you'll soar! So powerful, you'll be in awe! That's the HandBook 486 from Gateway 2000. Take flight with this compact little PC no matter where you go. Taking the world by storm with a footprint of just 9.75 inches by 5.9 inches, the HandBook 486 weighs in at (*are you sitting down?*) under three pounds! That's lighter than any Intel 486-based portable available today.

Still up in the air about the combination of portability and power? Head this way, because the HandBook 486 is a real PC and the only DX2 subnotebook found on any continent. No compromises here.

You'll get an IDE hard drive with up to 130MB, standard 4MB or 8MB RAM upgradable to 20MB, a backlit VGA screen, 78-key keyboard, EZ Point™ integrated pointer, and that terrific suspend/resume feature.

Whether you're a world traveler or an urban commuter, the Gateway 2000 ColorBook and HandBook offer you all the perks you deserve. So don't pick up the phone and go the "wrong way." Call Gateway 2000 straight-away!

intel inside

GATEWAY2000

"You've got a friend in the business."®

800-846-2063

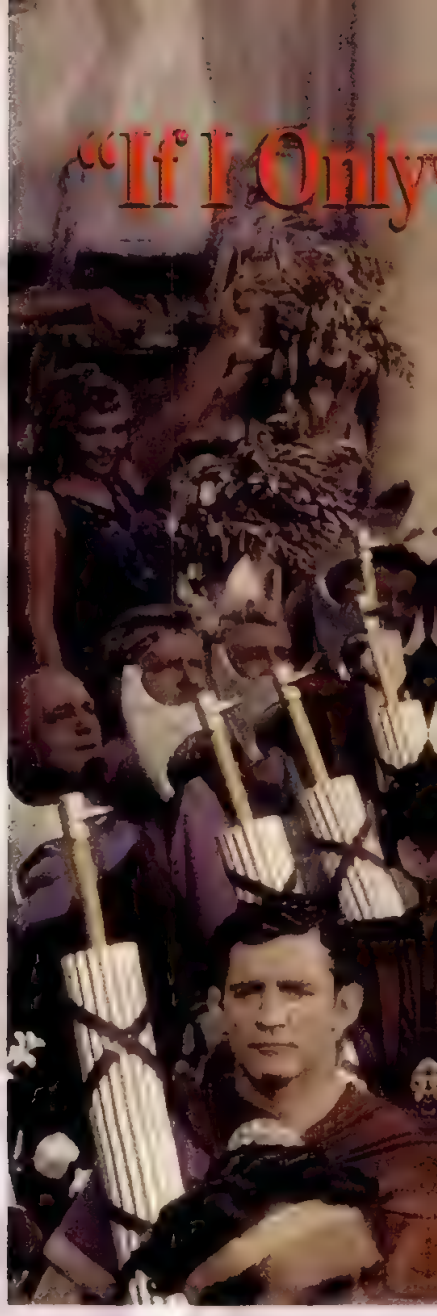
Ever have one of those days? I was eating my Eggs Benedict when the wife looked up and snarled, 'You're not going to hang out with those friends of yours today, are you?' What did she mean by that? These were guys in togas, they didn't have much to hide.

But even the oracle told me not to go to work, 'You shall regret the company you keep.' What did that mean? After years of running amuck, conquering empires, and going on Roman holidays together, I felt I knew these guys.

After making a stop at the V and X cent store for eucalyptus lip balm, I continued on to the Senate house. Second mistake of the day. The first was getting out of bed.

Even as my last breath passed my lips, I wondered, 'WHY?' Death at the hands of my closest friends, then a salad and one of the hottest months of the year named after me. Hardly a fitting end for a man of my stature. Just goes to show no matter how much time you spend with guys in togas, you never really know them.

Man, I wish I would've had friends in the business.



Sometimes it's hard to know who to trust, especially in the competitive PC arena. You'll find our honest, hard-working employees to be allies, supporting villages and empires alike — wherever Gateway 2000® computers are found. Our loyal customers have helped us to become a Fortune 500 company, but we're not resting on these laurels. Every Gateway 2000 employee is committed to our philosophy of providing customers with a quality product at an unbeatable value, along with the best service in the land. You have our word on it.

Service Allies

As a Gateway 2000 customer, you receive toll-free technical support for the life of your system. And with the purchase of a Gateway modem you'll get Triton's CoSession™ Host at no additional charge. CoSession Host, a remote diagnostic software,

Photo courtesy of Motion Picture & Television Photo Archive

HANDBOOK® 486

- Weight: 2.94 Lbs.
- Dimensions: 9.75" x 5.9" x 1.6"
- SL Enhanced Intel® 486 or DX2 Processor
- 4MB or 8MB RAM (expands to 20MB)
- 80 to 130MB IDE Hard Drive
- 7.9" Backlit VGA Display
- NiMH Battery & AC Pack
- Suspend/Resume Feature
- 1 PCMCIA Type II Slot
- EZ Point™ Integrated Pointer
- 78-Key Keyboard
- Parallel, Serial & PS/2® Ports
- MS Works for Windows™ 3.0
- MS-DOS® 6.2, WFW™ 3.11 & Serial Transfer Cable

HANDBOOK 486SX-25

With 25MHz 486SX CPU, 4MB RAM and 80MB Hard Drive

$1495

HANDBOOK 486SX-25

With 25MHz 486SX CPU, 4MB RAM and 130MB Hard Drive

$1595

HANDBOOK DX2-40

With 40MHz DX2 CPU, 8MB RAM, 130MB Hard Drive, Extra NiMH Battery and Leather Carrying Case

$2295

HANDBOOK 486SX-25

With 25MHz 486SX CPU, 8MB RAM, 130MB Hard Drive and Leather Carrying Case

$1895

PORTABLE OPTIONS

Peripherals and upgrades available only with purchase of a system.

PCMCIA Cards:

- TelePath™ 14,400/14,400 fax/modem. **$249**
- 9,600/2,400 fax/modem. **$149**
- Ethernet adapter. **$149**
- Token Ring adapter. **$449**
- HandBook VGA adapter. **$229**

Batteries:

- 2.2Ah NiMH batteries. **$89**

Diskette Drive:

- HandBook external 1.44MB. **$99**

Cases:

- ColorBook **$49**, HandBook **$55**

Extended VIP Warranty:

- We'll ship a replacement within 24 hours during warranty. Point of sale only. **$100**

COLORBOOK™

- Weight: Under 5.7 Lbs.
- Dimensions: 11.7" x 8.5" x 1.77"
- SL Enhanced Intel 486, DX2 or DX4 Processors
- 4MB or 8MB RAM (expands to 8, 12 or 20MB)
- 3.5" 1.44MB Diskette Drive
- Removable 120 to 250MB IDE Drive
- 10.3" or 9.4" VGA Dual-Scan STN Color Display
- NiMH Battery & AC Pack
- Suspend/Resume Feature
- 2 PCMCIA Type II or 1 Type III Slots
- Integrated Trackball (2 buttons)
- 85-Key Keyboard
- Parallel, Serial & PS/2 Ports
- External VGA Port
- MS Works for Windows 3.0
- MS-DOS 6.2 & WFW 3.11

COLORBOOK 486SX-33

With 33MHz 486SX CPU, 4MB RAM, 120MB Hard Drive and 9.4" LCD

$1995

COLORBOOK DX2-40

With 40MHz DX2 CPU, 4MB RAM, 250MB Hard Drive and 10.3" LCD

$2495

COLORBOOK DX2-50

With 50MHz DX2 CPU, 8MB RAM, 250MB Hard Drive and 10.3" LCD

$2995

COLORBOOK DX4-75

With 75MHz DX4 CPU, 8MB RAM, 250MB Hard Drive and 10.3" LCD

$3495

COLORBOOK PACKS

Peripherals and upgrades available only with purchase of a system.

Traveler's Packs:

- Case, extra battery & PCMCIA 9,600/2,400 fax/modem. **$279**
- Case, extra battery & PCMCIA TelePath fax/modem. **$369**

SOFTWARE & EXTRAS

If a system comes with "choice of application software," choose one of the following packages:

- Microsoft Excel for Windows™
- Microsoft Word for Windows™
- Microsoft Word and Bookshelf,® CD-ROM Edition
- Microsoft PowerPoint for Windows™
- Microsoft Project for Windows™
- Microsoft Access™ for Windows
- Publisher's Pack (CD-ROM only; includes CorelDRAW 3,™ ArtShow, MS Publisher 2.0 & MS Design Pack)
- The Entrepreneur Pack (Works,™ Publisher,™ Money™ & games)
- Borland Paradox® and Quattro® Pro for Windows spreadsheet
- Borland Paradox® and C++ (CD-ROM only)

With desktop and selected portables you also get the following software and extras at no additional charge:

- MS-DOS 6.2 & Windows for Workgroups 3.11
- CoSession™ Host Remote Diagnostics (with all modems)
- QAPlus Diagnostics
- Gateway Computer Glossary
- Gateway Mouse Pad

Systems with CD-ROM drives also include:

- Gateway System CD
- On-Line User's Guide
- Gateway Mall On-Line Catalog

SERVICE

Every Gateway system is backed by:

- 30-Day Money-Back Guarantee
- One-Year Limited Warranty
- Lifetime Toll-Free Technical Support
- On-Site Service Available To Most Locations For Desktop Systems
- Lifetime BBS Membership
- FaxBack Automated Fax Service

Our money-back guarantee does not include shipping. On-site service is provided at no charge during warranty if our technicians determine it is necessary. If you'd like to read our warranty and guarantee policies, please call for a free copy.

Printed on recycled paper with soy inks.

Gateway 2000 is a corporate sponsor of GLOBAL REOLEAF

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also get your choice of one great software bundle from our Family PC software bundles. When you choose our Microsoft® bundle, you'll get MS Encarta, Golf, Money, and Works Multimedia Edition 3.0.

Encarta gives you the complete text of the 29-volume 1992 Funk & Wagnall's New Encyclopedia. Discover a whole new universe with 25,000 articles, 350 music segments, over 100 readings by authors, and samples of more than 45 languages.

You can hit the links year-round with Microsoft Golf. Play the famous Torrey Pines golf course, pick 14 clubs for every game, and consult a golf pro. Walk over the lush course and hear the swish of your club with photo-realistic scenery and real audio.

Use Microsoft Money to take complete control of your finances quickly and easily. You'll always know where your money is, and where it's going with this complete set of financial tools.

These are just a few of the many possibilities of a Family PC from Gateway 2000. Call today for more information on these incredible systems.

Our Family PC comes with a 14-inch color SVGA monitor, 101-key keyboard, double-speed CD-ROM, sound card, speakers, joystick, fax/modem and mulitmedia software. You choose one software option from our great Family PC multi-title packages.

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The Gateway 2000 Family PC™

Listen and watch legendary figures make speeches, or play interactive games, or get a jump on work from the office — all at home! For all ages, every day of the year, the Family PC from Gateway 2000 fits right into your lifestyle with full multimedia capabilities including sound, pictures, animation *and* video.

Priced from $1,495, our Family PCs are loaded with everything you need for a reference library, entertainment center and home office: double-speed CD-ROM drive, 340MB hard drive, data/fax modem, sound card, speakers, and joystick. You

GATEWAY2000

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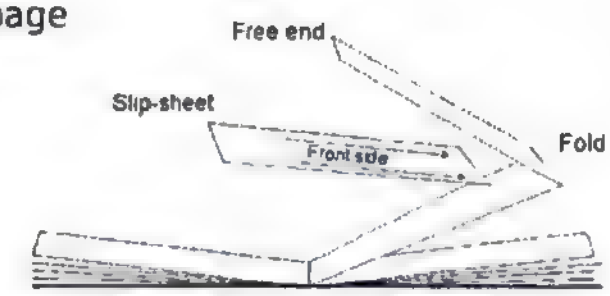
Folded edge of the page

GbsSlipSheet-001

Foldout slip-sheet

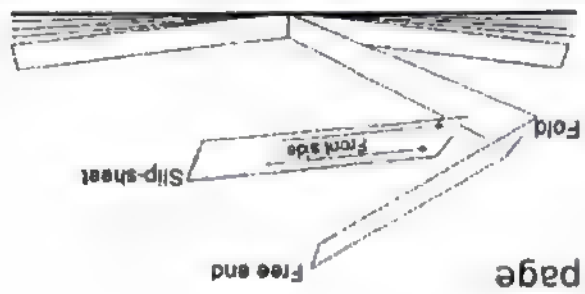
1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

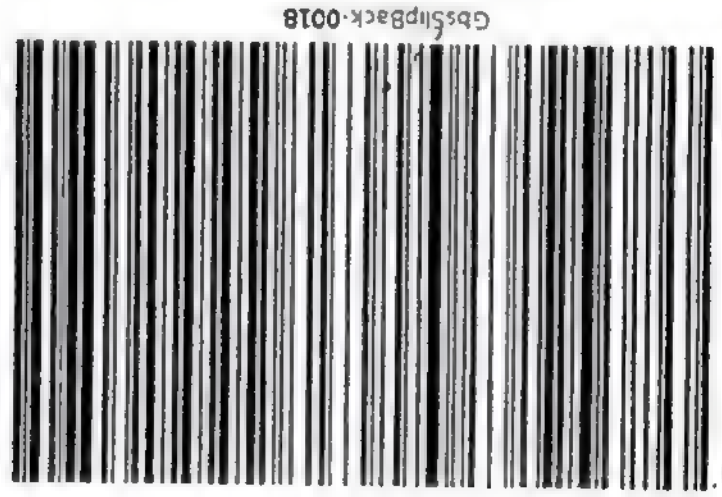


Folded edge of the page

Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet





Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

Would've Had Friends In The Business"

Julius Caesar was head of the Roman empire from [illegible] at the Roman Senate house by his friends. Julius [illegible] friends in the business.

allows Gateway technical support representatives to troubleshoot your system on-line. They can also edit configuration files; run diagnostics; upload new drivers and files and, in most cases, install them for you

You also get a lifetime Gateway Bulletin Board System (BBS) membership with the purchase of a system and modem. This on-line service gives you a convenient way to communicate with us or with other users. On-line technical support, customer service and sales information are only some of the benefits of Gateway's BBS service. You can also download updated drivers, files and utilities for your Gateway PC through the BBS.

Payment Options

Gateway accepts most major credit cards and C.O.D. terms, with net 30-day terms and leasing options available to qualified commercial customers. You can also apply for the Gateway 2000 DuoLine™ MasterCard® Card, issued by Dial National Bank. You can make purchases from Gateway and anywhere else MasterCard is accepted with two lines of credit — one for Gateway purchases and one for all other transactions. For Gateway purchases, the card has no annual fee and a low variable interest rate of just 12.9% APR. For other transactions, you get a variable interest rate of 13.9% APR and a low $18 annual fee.*

**Cash advance fee is $1 plus 2% of the amount of the cash advance, but not less than $5 nor more than $10. Financing is available on approved credit with the Gateway DuoLine MasterCard, issued by Dial National Bank, Des Moines, Iowa. The Annual Percentage Rates shown above are current as of April 1, 1994.*

Bonanno, "Wrong Way," and Julius all portrayed by Gateway 2000 employees

INTEGRATED SYSTEMS

4SX-33*/4DX-33*

- Intel® 33MHz 486SX or DX CPU
- 4MB RAM
- 340MB 13ms IDE Hard Drive
- Local Bus Graphics with 1MB
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■ SCSI

SCSI Comes to PCI with Speedy Results

BY JAMES KARNEY

If you've got a PCI-based PC or server, you want the fastest PCI peripherals you can find—and both Adaptec and QLogic can help with bus-mastering SCSI host adapter boards. You use them to connect fast SCSI hard disks or other SCSI peripherals to your system for maximum I/O performance.

Adaptec's $399 AHA-2940 PCI-to-Fast SCSI host adapter is notable for its easy installation and excellent utilities. There are no jumpers or switches anywhere. All configuration settings, including SCSI bus termination, are made using Adaptec's SCSISelect software. Adding a CD-ROM drive and tape backup unit is easy with Adaptec's EZ-SCSI software.

QLOGIC: *PCI SCSI host adapters speed up peripherals.*

Other bundled software includes drivers for Windows NT, OS/2, NetWare, and Unix.

The AHA-2940 has Adaptec's new PhaseEngine 10-MIPS RISC processor and supports up to six standard SCSI-2 and SCSI-1 devices.

QLogic's new $359.95 Fast!-SCSI IQ PCI adapter is based on QLogic's ISP 1020 processor, an 8-MIPS RISC chip. It offers both internal Wide- and Fast-SCSI connectors, as well as a 68-pin external connector. Any two connectors can be used simultaneously.

Our experience installing the QLogic adapter demonstrated the difficulties PCI users are having with compatibility today. The adapter was incompatible with our test platform, a Pentium-based PCI system. We had to remove the adapter's BIOS and then boot from a floppy disk that contained SCSI device drivers to make it work. A fix is on the way for the QLogic board, but we've seen similar problems when testing other PCI products, so be sure to verify compatibility before making any PCI purchases.

QLogic's installation routines are not as refined as Adaptec's. We had to set termination jumpers on the Fast!SCSI board, and the setup program wasn't as easy to use. Once we had the board installed, it operated without problems. Allowing for QLogic's driver overhead, the two boards showed an average throughput of about 4MB per second on a Windows-based Pentium system.

The ease of installation and potential for high performance make PCI SCSI a natural for intensive I/O applications. These adapters are worth investigating if you want to get the most out of your new PCI-based system.

▶ **Adaptec AHA-2940 PCI Fast SCSI.** List price: *$399. Adaptec Inc., 691 South Milpitas Blvd., Milpitas, CA 95035; 800-934-2766, 408-945-8600; fax, 408-262-2533.*
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▶ **QLogic Fast!SCSI IQ PCI.** List price: *$359.* QLogic Corp., *3545 Harbor Blvd., Costa Mesa, CA. 92626; 800-867-7274, 714-438-2200; fax, 714-668-6950.*
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■ Illustration

Designworks 2: Back to the Drawing Board

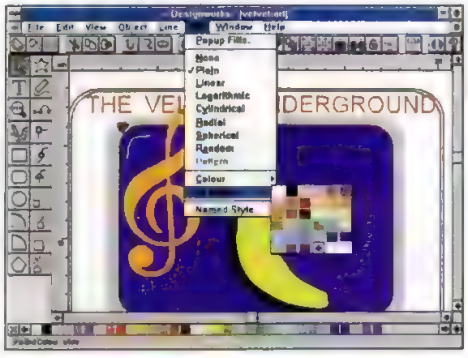
BY JOHN MOORE

GST Software's Designworks 2 for Windows ($195.95 list, $79.95 through December) has a friendly interface, basic drawing capabilities, and a collection of utilities that make it look good on the surface, but it leaves a lot to be desired if you need to create professional-quality illustrations.

Designworks has all the basic drawing tools, and scale, skew, rotate, and reflect tools that allow you to manipulate shapes. The program also provides a variety of gradient fills, supports four-color separations, and works in CMYK, RGB, HLS, and Pantone color models.

Its clean interface includes a movable, configurable toolbar, buttons along the top to access the most commonly used functions, and a hint line at the bottom. You can edit colors by double-clicking on any color in the palette at the bottom.

Though Designworks can't draw 3-D shapes, you can simulate 3-D objects by combining two shapes with the Blend tool. You can set up to 100 blend stages; otherwise, you're quite limited in what you can do with blended objects. As is the case with the Blend tool, most of Designworks' drawing tools aren't very well implemented. For example, the curve tool behaves in a way that is remarkably similar to the way the Bezier tool does—when using either one, the nodes tend to get in the way, making it difficult to see exactly what your results are until you've deselected the object.



LIVING COLOR: *In Designworks, you can either choose the colors to be applied to gradient fills or create your own.*

Designworks has strong text kerning tools, but its other text-handling capabilities come up short. Though you can link text into the program through OLE 2.0, you can't import text directly from other applications; you have to paste it from the Windows Clipboard.

What's worse is that your artistic control over text is very limited. In order to flow text along a path, you must first draw or select the path you want, then select both the path and the text block, and then apply the Join option. There are no options for wrapping text around an object or flowing text across multiple columns.

Designworks may be suitable if you need to make simple illustrations quickly, but if your needs go beyond that, you'll be frustrated by the minimal level of control the program offers. With comparably priced packages such as Aldus IntelliDraw on the market, it's hard to recommend Designworks for professional-quality illustration work.

▶ **Designworks 2 for Windows.** List price: *$199.95.* Requires: *2MB RAM, 3MB hard disk space, Microsoft Windows 3.1 or later.* GST Software, *P.O. Box 26204 Minneapolis, MN 55426; 800-236-1062, 612-544-4890; fax, 612-544-4890.*
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■ **Multimedia**

Q/Media Blends Glitz into Your Presentations

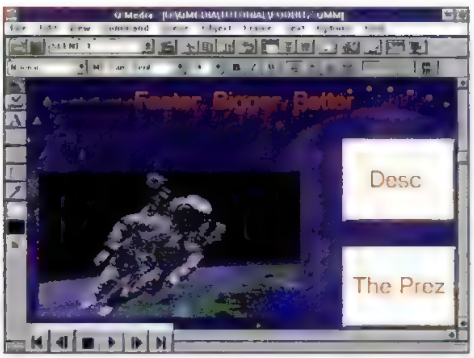
BY DAVID HASKIN

Q/Media for Windows 2.0, a $199 multimedia authoring tool that looks and acts like a presentation graphics program, won't satisfy power users of either type of software. Still, it fills a niche by being simple enough to encourage novice multimedia users and powerful enough to add multimedia flash to presentations.

As in a presentation graphics program, you work in one of three views: the Scene, the Scene Sorter, and the Outliner. The poor implementation of the Outliner and the program's inability to generate graphs, audience handouts, and presenter's notes make Q/Media unlikely to supplant your regular presentation program. And without scripting capabilities for automating complex user interactions, it won't replace high-end multimedia authoring programs, either. Like those authoring tools, Q/Media gives you a significant amount of control over the contents and behavior of each scene.

You can start presentations from scratch or, more impressively, import them from other presentation programs. You can add multimedia objects by dragging them from a dialog box into a scene. Q/Media supports OLE 2.0, so you can also add objects by dragging them from other OLE 2.0–compliant programs.

Q/Media's timelines simplify the synchronization of multimedia objects. The Timeline dialog box has a slider bar for each multimedia object in the scene and a time scale. You set the precise time at which an object enters and exits the scene by dragging the ends of the object's slider bar. You can also set entry and exit transition effects such as fades and wipes for on-screen multimedia objects.



FAMILIAR WORKSPACE: *You develop multimedia presentations in slide or outline views.*

Branching options let you jump to a specific scene, pause for user input, display an on-screen message, run a program, or launch an embedded multimedia object.

While Q/Media is a simple and reasonably thorough authoring tool, it has some exasperating omissions. For example, you can't preview background templates or transitions between slides before you apply them to scenes. Nor can you loop a music clip so that it plays continuously or apply a music clip to an entire presentation.

More powerful (and expensive) products such as Gold Disk's $399 Astound have richer capabilities for both multimedia and standard business presentations, but Q/Media is a good choice if you're just starting in multimedia or need to add a bit of multimedia glitz to your presentations.

▶ **Q/Media for Windows 2.0.** List price: *$199.* Requires: *4MB RAM, 5MB hard disk space, Microsoft Windows 3.1 or later.* Q/Media Software Corp., *312 E. 5th Ave. Vancouver, B.C. Canada V5T 1H4; 604-879-1190; fax, 604-879-0214.*
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■ **Windows Utilities**

FrontRunner: A Windows Shell for DOS Users

BY BARRY SIMON

If you're a fan of DOS apps and you use Windows mainly for task switching, FrontRunner (Phar Lap Software's $139 Windows utility) may give your work more of a multitasking feel.

When you use FrontRunner, you can launch DOS sessions as part of your Windows startup, from a File Run dialog box, from a pull-down menu off a Program Manager group, or from FrontRunner's own Launch toolbar.

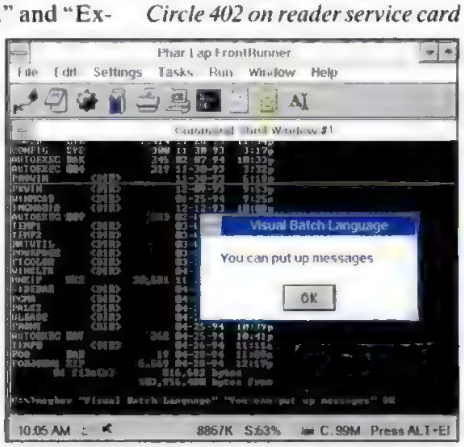
These DOS sessions can run full-screen, but FrontRunner really shines when you run them as MDI child windows inside the FrontRunner window. FrontRunner windows have scroll-back memory so you can view what has scrolled off the screen.

FrontRunner also smoothes cut-and-paste operations among DOS programs. Mark a block with your mouse and click to copy it to the Windows Clipboard. Hit the right mouse button over a DOS window, and the Clipboard contents will paste back in.

FrontRunner includes a set of Visual Batch extensions that let DOS batch files run in a pop-up Windows-style message box. If you type the name of a Windows app at the command line in a DOS box, FrontRunner launches it.

You can configure FrontRunner's status bar to show free disk space, free memory, the time (but not date), and the first part of any text in the Clipboard. The Launch toolbar lets you place quick launch buttons at the top of the FrontRunner window. There's also a File Find dialog box that searches for filenames or text within files.

There are a couple of design limitations and flaws in this first version. DOS sessions that run under FrontRunner must be set to "Background On" and "Exclusive Mode Off." Since DOS sessions are MDI windows, they do not appear on the standard task list or in Alt-Tab quick-switching. Icons of minimized applications will show up only if you launch the programs from FrontRunner, not if you launch them in your startup group. Phar Lap says that these issues and others will be addressed in upcoming releases.



DOS IN WINDOWS: *FrontRunner has backward screen scrolling and can call up Windows dialog boxes in DOS batch files.*

▶ **Front Runner, Version 1.0.** List price: *$139.* Requires: *4MB RAM, 2MB hard disk space, Microsoft Windows 3.1 or later.* Phar Lap Software Inc., *60 Aberdeen Ave., Cambridge, MA 02138; 800-292-9622, 617-661-1510; fax, 617-876-2972.*
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■ **Data Access and Reporting**

Forest & Trees 3.1 Drills Down into Your Business

BY JOE SALEMI

Version 3.1 of Forest & Trees, one of the premier data access and reporting tools on the market, is the first version to be released by its new owners, Trinzic Corp. The updated program benefits from Trinzic's experience in the client/server field; it features a number of new modules for both standard PC and client/server databases.

The Standard Edition ($695) can access a number of PC-based data formats including DataEase, dBASE, Excel, Lotus 1-2-3, Lotus Notes, Paradox, Q&A, and R:Base databases. The Client/Server Edition ($790) adds support for database servers. (Quantity discounts are available for both versions.)

Forest & Trees' strength has always been its data analysis capabilities. You can combine data from any or all of the supported sources to create complex views. Different views combine in a treelike structure for graphing, reporting, and analysis. The data views update in real time or on a user-defined schedule. You can also set triggers and alarms that alert you to conditions you define. The result is a sort of electronic dashboard that feeds you up-to-date information about your business.

Version 3.1 draws several new graph types, including 3-D bar, line, area, Gantt, and scatter charts. Trinzic has also added "drill-down" capabilities to the graphs, so you can click on a data point and view the underlying values it's derived from.

Forest & Trees lets you add radio buttons, check boxes, picture buttons, and customized help screens to a view. The editing and layout features are also improved, taking better advantage of Windows' graphical capabilities.

The Client/Server edition extends Forest & Trees' reach to common database servers, including both Microsoft and Sybase versions of SQL Server, NetWare SQL, IBM's DB2/2, Informix, Ingres, ORACLE, SQLBase, and any other database supported by ODBC (open database connectivity).

Most organizations find that critical data gets scattered among a number of different files and applications as time passes. Forest & Trees gives you an easy way to pull that data together in one place so you can clearly see what's going on.

WHAT'S GOING ON: *Forest & Trees 3.1 adds enhanced graphing capabilities—including drill-down charts—to its data analysis capabilities.*

▶ **Forest & Trees 3.1.** List price: *Standard Edition, $695; Client/Server Edition, $790; upgrade, $169.* Requires: *3MB RAM; 3MB hard disk space, Microsoft Windows 3.0 or later.* Trinzic Corp., *One Harbour Place, #500, Portsmouth, NH 03801; 800-952-8779, 603-427-0444; fax, 603-427-0385.*
Circle 425 on reader service card

■ **OS/2 Utilities**

SkyScraper Elevates Your OS/2 Desktop

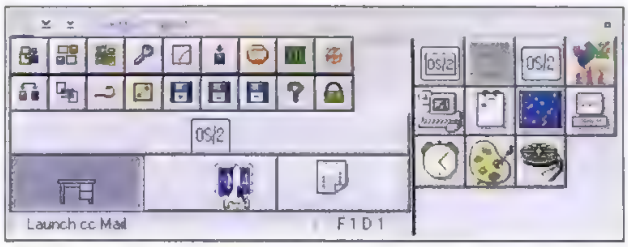
BY AMARENDRA SINGH

If Windows users need dozens of Program Manager replacements (and the market says they do), then surely OS/2 users need a good replacement for the WorkPlace Shell. Binar Graphics has released a worthy candidate: SkyScraper, Desktop Manager for OS/2. This $99 program is easy to use and comes packed with a powerful set of tools that let you set up a series of virtual desktops and a compact program launcher.

SkyScraper's primary interface is a control panel with several individual components. Most notable is the program launcher, which holds icons representing applications. Adding program icons representing either groups or individual applications is as simple as dragging them onto the program launch area while you hold down the left mouse button.

Once the icons are in place, you launch the app with a single right-mouse-button click. The left button brings up the settings for the programs. A status bar in the lower-left-hand corner gives you information about both the icon your mouse is pointing at and the other SkyScraper controls in the virtual desk areas.

A separate SkyScraper desk control area switches among the virtual desks you create. These desks can be configured in a grid of 68 "floors" by 51 "desks," resulting in a total of 3,468 possible screens. Most users will find one to three floors and desks to be comfortable.



SHELL GAME: *SkyScraper includes a program launcher and controls for virtual desktops.*

There's also a OS desk area that represents full-screen OS/2 and DOS sessions. To switch among desks, you click on your desktop of choice, and to launch an application on one of these desks, you drag the icon onto it.

SkyScraper comes with a number of tools that let you consolidate all applications onto one desk, arrange all the open applications into their own desks, or call any open application to the current desk. Almost all of the components can be turned on or off, including which elements you view.

Any OS/2 user looking for a compact program launcher and desktop shell would be well-advised to visit SkyScraper. You can use it as a complement for the Workplace Shell to help you harness the multitasking power of OS/2.

▶ **SkyScraper, Desktop Manager for OS/2.** List price: *$99.* Requires: *4MB RAM, OS/2 2.0 or later.* Binar Grahpics Inc., *30 Mitchell Blvd., San Rafael, CA 94903; 800-228-0660, 415-491-4182; fax, 415-491-1164.*
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■ **Desktop Publishing**

MyBrochures Needs More Design Flexibility

BY MELISSA J. PERENSON

MySoftware Company's $59.95 MyBrochures is good at what it does, but it doesn't do enough to satisfy creators of flyers and brochures who have seen the power of more versatile low-end desktop publishing packages.

Geared toward everyone from small-business owners to personal users, MyBrochures creates professional-looking, three-panel brochures on standard letter-size paper or preprinted brochure paper from Paper Direct and other paper vendors. Beginners who are looking for a jump start can use the wide selection of already designed, customizable brochure templates.

There are three brochure options. In addition to a standard brochure, you can add an outline for a Rolodex card or create a tear-along-the-dotted-line return card. The interface is clean, with a toolbar for easy access to basic drawing tools. Bright points include a search-and-replace feature, a spell-checker, simultaneous previews of both sides of the brochure, a table function, the ability to import text files, and automatic bullet alignment with the text.

TRI-FOLD: *MyBrochures lets you work in WYSIWYG mode.*

The package comes with a respectable stable of clip art that can be supplemented by imported images in several formats.

Unfortunately, for each feature that's a convenient and useful boon, there's another function that's lacking. For example, you can't drag-and-drop blocks of text for precision positioning that would, among other things, keep text from colliding with the paper's designs. There's no flexibility in locating the address fields, Rolodex card, and tear-off panel; all are fixed fields. Plus, the program is set up so that you can make *only* three-panel brochures.

The biggest drawback is that you can't rotate text, which commits your text to a landscape orientation on the paper. This is a particularly annoying point when you want to include text on the same page as the address fields. If you're planning large mailings, you'll need the program's mail-merge capability: It supports dBASE, dBF, and MySoftware's MyMailist and MyDatabase formats.

MyBrochures is a promising option if you want to create customized brochures for large mailings, but the program's shortcomings are bound to make you yearn for more—and even the most undemanding users will eventually want more flexibility in designing their perfect brochure.

▶ **MyBrochures.** List price: *$59.95.* Requires: *4MB RAM, 3MB hard disk space, Windows 3.1 or later.* MySoftware Co., *1259 El Camino Real, #167, Menlo Park, CA 94025. 800-325-3508, 415-325-9383; fax, 415-325-3106.*

Circle 429 on reader service card.

■ **Windows Utilities**

WindowMagic: Low-Impact Approach to Organization

BY CAROLE PATTON

Version 3.0 of WinWear's $89.95 WindowMagic desktop organizer is a major upgrade from a company that hasn't forgotten the programmer's golden rule: Write tight code. There are four new productivity applets—Get-It, Disk-It, Print-It, and X-It—plus enhancements to the program's ToolBars, QuickAccess, and FastLaunch. The cost in hard disk space for all these improvements? A mere 500K.

WindowMagic's winning characteristic is its ability to organize Program Manager without changing it. Your SHELL= statement still points to Program Manager, and there's very little new to learn. You organize Program Manager by assigning customized WindowMagic icons to minimized groups. WindowMagic makes these groups accessible via a neat little Get-It applet.

HELPING HAND

As you start to use WindowMagic, the Get-It "hand" icon quickly becomes essential for multitasking assistance. When more than one window is active, the Get-It hand is located on the active title bar (next to the system box) in the upper-left-hand corner of your screen. If all your programs are minimized, you will always find the hand at the top of your screen.

Clicking on the Get-It hand brings up a menu that allows you to switch to any application that is currently running. You click on the hand to launch an application on the fly, or to activate another WindowMagic applet such as Print-It or Run-It. Likewise, you click on the hand to bring up your list of favorite programs (indicated by a red heart), do standard Task Manager chores (like Arrange, Tile, or Cascade your windows), or display the clock without obstructing your desktop.

HELPING HAND: *WindowMagic makes it easy to organize your Program Manager.*

Other new WindowMagic components include Print-It, which lets you drag your documents onto an icon for printing; Disk-It, which puts disk-drive icons on your desktop (including a CD-ROM drive); Run-It, which saves File Run commands for faster program access; and X-It, for a fast Windows exit.

Many other Windows utilities do some of what the WindowMagic program does (and WindowMagic doesn't do everything), but as a low-impact tool for making some sense out of Windows, WindowMagic achieves its goal.

▶ **WindowMagic, Version 3.0.** List price: *$89.95; introductory price through August 31, $49.95.* Requires: *Microsoft Windows 3.1 or later.* WinWear Inc., *14150 NE 20th, #346, Bellevue, WA 98007; 800-803-9358, 206-635-0856; fax, 206-635-0823.*

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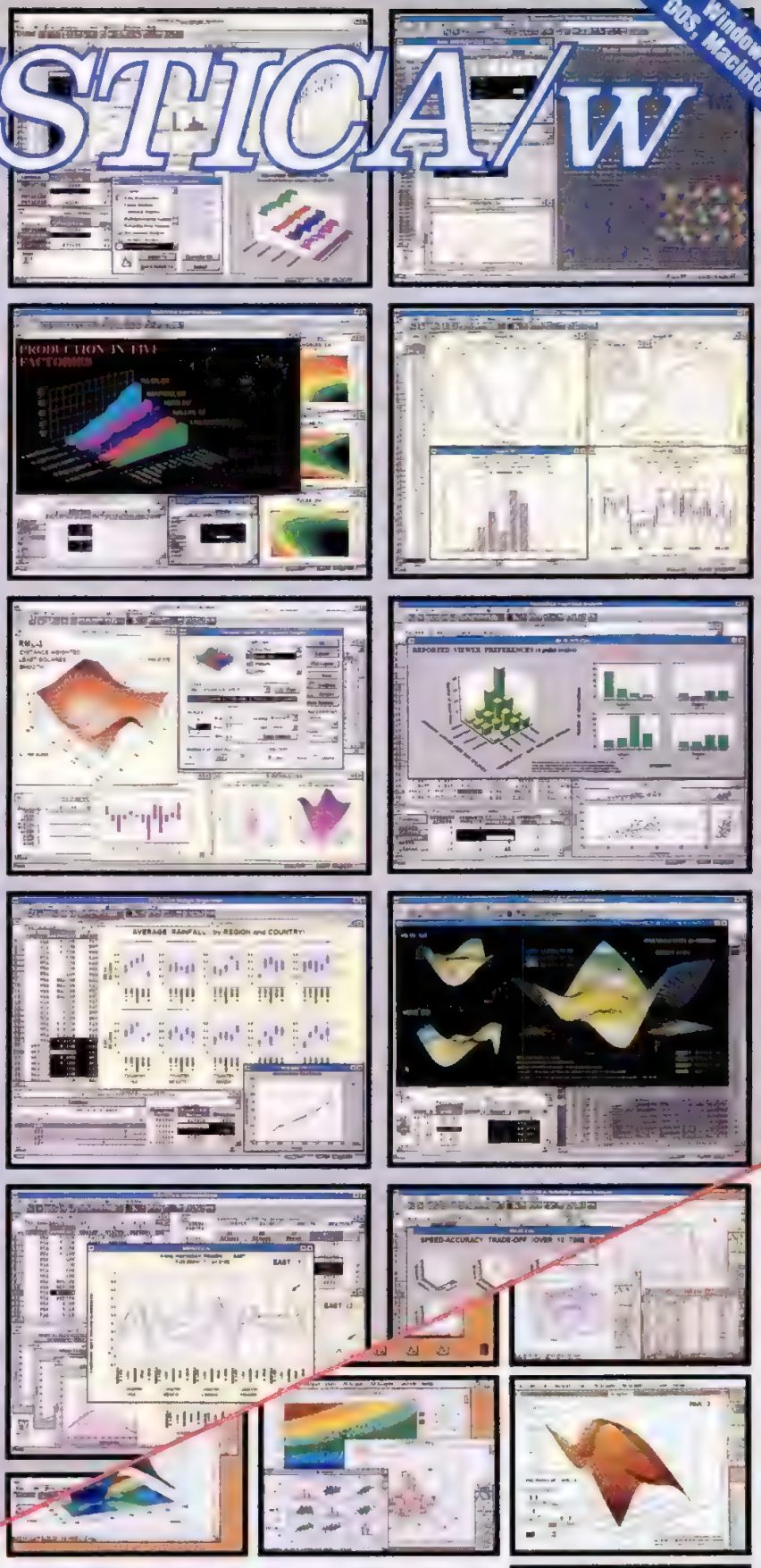
STATISTICA/w

Windows, DOS, Macintosh



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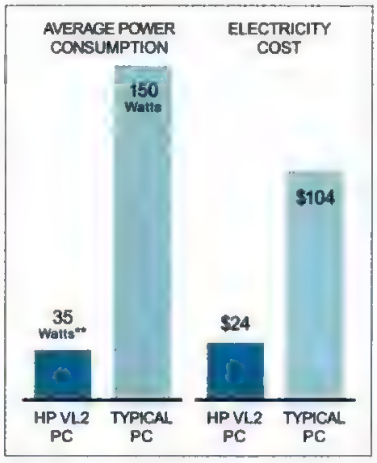

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CIRCLE 226 ON READER SERVICE CARD

New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Adam A. Hicks

NEW

Jumbo Hard Disks Coming This Fall from Conner

Look at the specs for **Conner Peripherals'** upcoming series of 3.5-inch hard disks and your idea of an "average" PC will change. The Filepro Advantage series, which will ship in September, will come in 425MB, 850MB, and 1.27GB formatted capacities. All three hard disks will be available in Enhanced IDE or SCSI-2 interfaces. You'll also find a maximum IDE-bus transfer rate of 16.7MB per second, combined command queuing for efficient SCSI-2 data retrieval, a standby mode (which consumes only 1 watt during inactive periods), and Conner's own "Cache Boost" disk caching.

▶ **Conner Filepro Advantage 425.** List price: *$255.* **Conner Filepro Advantage 850.** List price: *$399.* **Conner Filepro Advantage 1260.** List price: *$599.* Conner Peripherals Inc., *3018 Zanker Rd., San Jose, CA 95134; 800-526-6637, 408-456-4000.*

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IMPROVED

ATM 3.0 Promises Fontastic Results

With Adobe Type Manager, Version 3.0, **Adobe Systems** brings to Windows the same kind of multiple-master fonts that it provides for the Macintosh. Such fonts are user-adjustable on several axes; just one can generate thousands of variations. ATM 3.0 comes with the Tekton multiple-master font, and nine others are available for $69 each. ATM 3.0 also contains 17 additional fonts. Every Adobe Type Library sold at retail now includes ATM.

Adobe has also announced new software licensing arrangements (based on the number of PCs using the software, rather than the number of printers), has added better network control for font management, and has cut the prices on all of its typefaces by 25 percent.

▶ **Adobe Type Manager, Version 3.0.** List price: *$60; upgrade, $29.95.* Adobe Systems Inc., *1585 Charleston Rd., P.O. Box 7900, Mountain View, CA 94039; 800-521-1976; 415-961-4400.*

Circle 406 on reader service card.

HOT PROSPECT

XSoft Will Change the Way You Look At Document Management

Visual Recall is a unique document management system for any NetWare-based workgroup. XSoft has combined two technologies that were originally researched and developed by the famous Xerox Palo Alto Research Center (PARC), and is making them available commercially for the first time in a single innovative Windows package.

Visual Recall has a powerful full-text database engine with advanced linguistic comprehension capability, which allows you to create searchable full-text indexes of any type of file. Your database searches can be based on user-definable file attributes, word strings within the files, or even word *stems* within the files (a search for "mice" will also find "mouse").

What's most interesting is the way Visual Recall displays search results to give you insight into where your files are located and how they are being used in the workgroup. Instead of showing you a list of matching filenames, a Tree View displays search results according to the relationships between file attributes in a 3-D representation of the information. Similarly, a Grid View displays documents in relation to one another over a period of time, giving you an idea of when groups of tasks are accomplished.

▶ **Visual Recall.** List price: *$395.* XSoft, A Division of Xerox, *3400 Hillview Ave., Palo Alto, CA 94304; 800-428-2995, 415-813-6920; fax, 415-813-7162.*

Circle 403 on reader service card.

NEW

CD-ROM Guide to Your Own Private Eden

It may be too late to plant your garden for this summer, but The Exotic Garden CD-ROM from **VT Productions** can teach you all you need to know for next year. This MPC Level 1–compliant CD-ROM provides four search paths to botanical studies, whether you want specific details or simply a picture show. The disk contains 500 color photographs and a narrated time-lapse film called *Why Plants Flower.* The photos are accompanied by the flowers' Latin names and their pronunciations, as well as information on such aspects as native habitats and plant care.

The Exotic Garden CD-ROM provides detailed information and photos of 500 plants and flowers.

▶ **The Exotic Garden.** List price: *$49.95.* VT Productions, *511 Calle Serra, Aptos, CA 95003; 408-464-1552; fax, 408-464-1554.*

Circle 407 on reader service card.

NEW

Konexx Keeps the Acoustic Coupler Concept Alive

Instead of searching for the right phone to connect your notebook to, you may want to try a connector that will work with any phone. **Unlimited Systems Corp.** has released a portable device that can make your notebook talk to any type of phone, including cellular and airplane phones. The Konexx Koupler Model 204 cradles the phone's receiver and transmits analog signals from your modem or portable

Photography by Thom O'Connor

The Konexx Koupler Model 204 with RJ-11 jack.

fax machine via an RJ-11 connection. The device weighs only 9 ounces and transmits at a slow 2,400 bps on standard pay phone lines. Unlimited Systems also sells the Konexx Modem Koupler Model 305, which has a built-in 2,400/9,600-bps data fax modem. The 305 connects directly to your notebook with either a 9-pin or 25-pin serial connector and ships with Windows and DOS communications software.

▶ **Konexx Koupler Model 204.** List price: *$149.* **Konnex Modem Koupler Model 305.** List price: *$299.* Unlimited Systems Corp., Inc., *8586 Miramar Pl., San Diego, CA 92121; 800-275-6354, 619-622-1400; fax, 619-550-7330.*
Circle 408 on reader service card.

NEW

Polaroid Has Three LCD Projection Options

Polaroid Corp.'s family of LCD panels proves that you do get what you pay for. Each system is basically the same 4.7-pound, 1.57- by 12.2- by 12.2-inch box with an 8.4-inch display and wireless remote controls, but depending on the price you pay, the unit may have added features and functionality.

If you have a limited budget and need only to project data, the Polaview 1500 has a passive-matrix screen that will support displays up to 256,000 colors. The Polaview 1800 has an active-matrix screen that supports 2.1 million colors and gives you the option of displaying video images (such as NTSC, PAL, and SVHS) with an external video adapter upgrade for $995. The Polaview 3000 supports all those display options at up to 16.7 million colors on active-matrix screen. All three units have a wireless remote control to adjust contrast and color balance, but only the 1500 and 3000 models' remotes will also control your mouse. These LCD panels will support both the PC and Macintosh platforms, have integrated cooling systems, and include plastic carrying cases.

▶ **Polaview 1500.** List price: *$3,495.* **Polaview 1800.** List price: *$4,995.* **Polaview 3000.** List price: *$6,995.* Polaroid Corp. Electronic Imaging Systems, *565 Technology Sq., Cambridge, MA 02139; 800-662-8337; fax, 617-577-3212.*
Circle 411 on reader service card.

BRIEFS

Large Monitors

Apple Computer's new Apple Multiple Scan 20 Display is a 20-inch Trinitron CRT monitor that includes an adapter for use with PCs. The $2,149 monitor has scanning rates up to 82 kHz horizontal and 150 kHz vertical, and also is capable of resolutions as high as 1,280-by-1,024 at 75 Hz. 800-767-2775; 408-996-1010.

Philips Consumer Electronics enters the 21-inch arena with the Brilliance 21A, which includes Philips' CyberScreen technology to reduce misconvergence by over 57 percent. The monitor, priced at $3,499, has a maximum refresh rate of 76 Hz at a resolution of 1,280-by-1,024. 800-835-3506, 615-541-5800.

ViewSonic also has a 21-inch, Energy Star–compliant offering. The ViewSonic 21 supports noninterlaced resolutions of up to 1,600-by-1,280 at refresh rates of up to 152 Hz, and is priced at $2,199. 800-888-8583, 909-869-7976.

Modems

Supra Corp. has announced that all of its V.Fast Class modems currently shipping will be fully upgradable to V.34 models. The upgrades will be priced at $69 through the end of November. Afterward, prices will drop to $49. 800-727-8417, 503-967-2410.

MultiTech Systems adds desktop conferencing to some models its V.32terbo MultimodemPCS and V.34 Multimodem modems using TalkShow document conferencing software from Future Labs Inc. The modems will be able to share documents in live communications links and give you the opportunity to pick up the phone to discuss the changes. With the voice- and data-conferencing features, the V.32 Multi ModemPCS is priced at $949, the V.34MultiModem at $799. 800-328-9717, 612-785-3500.

The Complete PC has begun shipping the TurboModem V.FAST in both internal ($229) and external ($279) models. Both modems are based on the Rockwell V.Fast Class chip set, transmit data at 28,800 bps, and use V.42bis and

NEW

Take Videos of Your Screen with Lotus ScreenCam

Full-motion video is worth a thousand screenshots and a manual. Lotus ScreenCam for Windows, from **Lotus Development Corp.**, is a screen and sound capture utility that lets you capture actual screen activity, including cursor movements. If you have a sound card, ScreenCam will also record your explanations of the movements in real time. The resulting film can be saved as an executable file or an embedded object that can be run full-motion, full-frame at up to 30 frames per second on any 386 system or better. Neither ScreenCam nor the recorded application is required on the system for playback.

Everything needed to run Lotus ScreenCam is in this single control panel.

It's perfect for sending tutorials, presenting new products, or explaining how you've developed an idea or process. Lotus is bundling the package with Lotus 1-2-3, Release 4 for Windows: Multimedia Edition.

▶ **Lotus ScreenCam for Windows.** List price: *$79.* Lotus Development Corp., *55 Cambridge Pkwy., Cambridge, MA 02142; 800-343-5414, 617-577-8500; fax, 617-693-0968.*
Circle 410 on reader service card.

IMPROVED

Quicture Does Word 6.0 Graphics

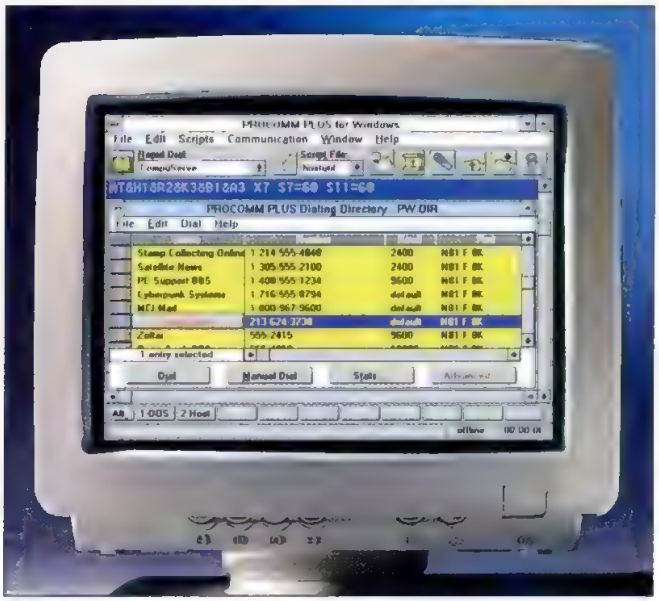
Quicture, Version 1.0a—graphics-handling software from **WexTech Systems**—now supports Microsoft Word for Windows 6.0. Quicture reduces file sizes by removing an image from the document, saves the image in a compressed version, and finally replaces it with a frame that holds the position and a description within the document.

The latest version, 1.0a, reduces the size of all your Word 6.0 graphics whether or not you created the documents, which gives this product an advantage over the file-linking feature you'll find in Word 6.0 (Word handles only graphics you bring in using the Insert Picture command).

▶ **Quicture, Version 1.0a.** List price: *$59.* WexTech Systems Inc., *310 Madison Ave., #905, New York, NY 10017; 800-939-8324, 212-949-9595; fax, 212-949-4007.*
Circle 409 on reader service card.

New Delrina WinComm PRO makes powerful communications easy. So why struggle with Procomm?

Delrina WinComm PRO™



Procomm Plus™ for Windows

To take part in the on-line revolution, you'll need a powerful communications package.

One that handles all major file transfer protocols, like Zmodem, Xmodem, Ymodem, Kermit and others. One that supports every popular terminal emulation. And has a powerful scripting language for automating on-line sessions.

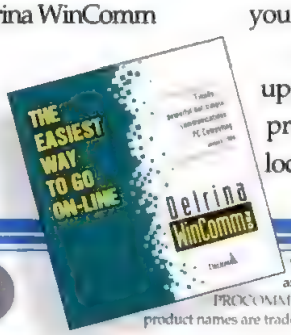
But perhaps you'd prefer software that puts that power right in front of you in a clean, intuitive interface. One that not only makes it easier to go on-line but simpler to do things once you're there. With features like a customizable, icon-based phonebook. Drag-and-drop file transfer. A customizable button bar where you can place your most common tasks. Even a scrollback buffer that lets you refer back to text from your current session, as well as text from previous sessions.

In that case the only choice is new Delrina WinComm PRO™. The one *PC Computing* called "...Intuitive enough for a novice user, yet still packed with enough sophisticated features to keep an on-line junkie happy."

	Delrina WinComm PRO	Procomm Plus™ for Windows*
Pre-defined scripts for on-line services	MCI Mail, CompuServe, GEnie, AT&T Mail, BIX, Delphi, Dow Jones & NewsNet	MCI Mail & CompuServe
Drag-and-drop file sending	Yes	No
Built-in script recorder	Yes	Yes
Phonebook	Customizable	Fixed
Split-screen session window	Yes	No
Scrollback buffer	200 pages	31 pages
Supports all popular file transfer protocols and terminal emulations	Yes	Yes
Virus detection during download	Yes	No
Shares a COM port with WinFax PRO	Yes	No
Integrated off-line text editor	Yes	No

Buy Delrina WinComm PRO alone, or as part of the money-saving Delrina Communications Suite™ which also includes Delrina WinFax PRO™, far and away the best-selling fax software in the world. Either way, you'll have the power you need and the ease of use you've only dreamed of.

Call for information or to upgrade from any Procomm product for just $49. Or see your local dealer to upgrade immediately.



DELRINA
1-800-268-6082

ATTENTION WINFAX USERS:
GET WINCOMM PRO FOR JUST $49. CALL TODAY

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CIRCLE 250 ON READER SERVICE CARD

OVER TWO MILLION LOTUS LIVES A LOT EASIER. THEY SW

Every day more people are jumping the fence to the most popular spreadsheet ever. In fact, over 10 million people are now taking advantage of the intuitive power of Microsoft® Excel.

The TipWizard™ assistant tracks your work and offers custom shortcuts.

It's just the smart thing to do. Microsoft Excel 5.0 is the only spreadsheet with built-in intelligence – our exclusive IntelliSense™ technology. So, like everything in the Microsoft Office, this program understands what you're doing and helps you get there with a lot less work. Simple tasks are automatic, more complex jobs are a breeze.

Say that you want to browse through all your data to find some sales totals. Click. AutoFilter shows you just what you want.

You can add those totals automatically with the Subtotal feature.

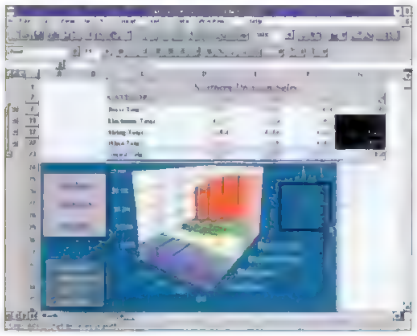
*Microsoft support is no-charge; however, normal telephone company charges may apply. Microsoft support services are subject to Microsoft's then-current prices, terms, and conditions, and subject to change without notice. Microsoft Office separately). In the 50 United States, call (800) 894-6642, Dept. 6SP. In Canada, for information only, call (800) 563-9048. Outside the U.S. and Canada, call your local Microsoft subsidiary or (206) 936-8661. Customers who are deaf or hard the Windows logo are registered trademarks and IntelliSense, TipWizard, PivotTable and Windows are trademarks of Microsoft Corporation. Lotus and 1-2-3 are registered trademarks of the Lotus Development Corporation.

USERS JUST MADE THEIR ITCHED TO MICROSOFT EXCEL.

Then expand or collapse the details of your worksheet with the Outlining buttons. Instantly. Like no other spreadsheet can.

Think about the analysis you do. Only Microsoft Excel gives you such easy, powerful access to information. With our PivotTable™ Wizard, it's a cinch to pull your raw facts into a clear summary report.

Then, with the PivotTable dynamic views, you can look at data



Instantly update your charts with Drag-and-Plot. Just drag in new data and you're done.

from different points of view—by product, region, quarter, whatever. Just drag and drop different headings to rearrange your report. As you go, your figures are immediately recalculated. So you see them in a whole new way.

Of course, Microsoft Excel is another smooth-fitting piece of the Microsoft Office, where the programs work together like one.

After creating a table or chart in Microsoft Excel, you can just drag and drop your work into Word.

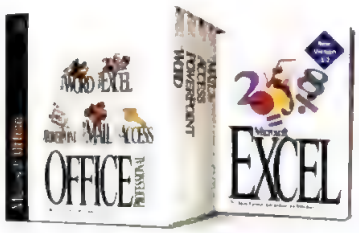
Any time you want to make changes, one click puts all of your spreadsheet tools back in action. Without leaving your document.

It's this OfficeLinks integration that lets you focus on your work, not on finding the tools you need.

Microsoft Excel customers get the best support around. Bar none. Furthermore, the programs in the Microsoft Office come with the only unlimited product support that has no service charge.*

And if you're a former Lotus® 1-2-3® user, relax. You can directly transfer files, even run existing macros. Easily. Enter a Lotus command and the Help for Lotus users feature lets you automatically see the Microsoft Excel equivalent.

So swing by your nearest dealer or call us at (800) 894-6642, Dept. 6SP. You'll see why the grass is greener on this side of the fence.



Microsoft.Office

Professional, shown here, includes: Microsoft Excel, Word, the PowerPoint® presentation graphics program and the Microsoft Access® database management system and a Mail workstation license (server and software must be acquired
of hearing can reach Microsoft text telephone (TT/TDD) services by calling (800) 892-5234 in the United States or (905) 568-9641 in Canada. © 1994 Microsoft Corporation. All rights reserved. Microsoft, Microsoft Access, PowerPoint and

NEW

WordPerfect Brings Comm Software to Main Street

As part of its new MainStreet line of products, which are targeted directly at mass consumer channels, **WordPerfect Corp.** has released ExpressFax+ 3.0 for Windows. ExpressFax+ was acquired by WordPerfect and optimized to create an entry-level Windows package that addresses basic communication software needs.

The package gives you access to standard features with single-click button controls, including a single phone book for fax and data numbers, an inbox and outbox to track your faxes, and the ability to fax short notes. The package also features Xerox Imaging Systems' TextBridge OCR (optical character recognition) software and has the ability to operate in terminal mode.

▶ **ExpressFax+ 3.0 for Windows.** List price: *$109.* WordPerfect Corp. *1555 N. Technology Way, Orem, UT 84057-2399; 800-321-4566, 801-225-5000; fax, 801-228-5077.*
Circle 412 on reader service card.

NEW

ARES' Mini-Tower Leaves Your Expansion Options Wide Open

Because standards don't have freshness dating to guarantee how long they will be good for, the more flexible your PC is, the better the chances are that it will stand the test of time. An ARES PCI/VESA Midtower from **ARES Microdevelopment** can help you cover your bets.

These systems provide you with a PCI/VESA motherboard and eight expansion slots. Three of the slots are PCI slots, two are VESA, two are ISA, and one is for either PCI or ISA, so you're not committed to one local-bus technology.

There are seven different models in the line, ranging from a 486SX/25 to a 486DX2/66. All of the models ship with 4MB RAM (expandable to 128MB), 256K external cache (expandable to 512K), a 420MB hard disk, and a Vision/LR 15-inch monitor. You can also choose either a Genoa Phantom PCI or VESA graphics accelerator with 2MB of RAM.

▶ **ARES PCI/VESA.** List price: *From $1,739 to $2,089.* ARES Microdevelopment Inc., *23660-A Research Drive, Farmington Hills, MI 48335; 800-322-3200, 810-473-0808; fax, 810-473-4450.*
Circle 413 on reader service card.

BRIEFS

Modems

MNP 5 data compression. You'll also get V.42 and MNP 2 to 4 error correction at all speeds. 407-997-9683.

Practical Peripherals is shipping four new 28.8 kilobits per seconds modems for all types of users. 800-442-4774, 805-497-4774.

The $499, 4.2-ounce PM288PKT V.FC is ideal for the traveler. It has two RJ-11 ports and uses a mini-DIN to DB9-pin serial cable. In addition to V.42 error control and V.42bis data compression, you get Group III 14,400-bps send/receive faxing, two-wire leased-line capabilities, and support for distinctive ring identification.

There are two models for the budget-minded: the PM288MT II V.FC (external) and the PM288HC II V.FC (internal). The 1.1- by 4.8- by 6.8-inch $399 external unit won't take up much room on your desk; you can put it under your phone or stand it on its side. The $379 internal model is a half-length card that includes a 16550 UART and a 16-character buffer.

The $529 PC 288 LCD V.FC modem has everything even the most demanding modem user could want. The unit measures 6.4 by 2.9 by 4.2 inches and includes 10 LED status lights and a three-line LCD for tracking 50 real-time modem status messages such as time of day, length of time on-line, or number of fax pages sent. The 288 LCD has built-in features that include synchronous and asynchronous operation, caller ID, and distinctive ring.

Low-Cost Accounting Software

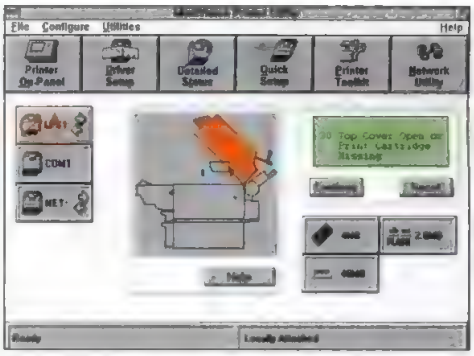
CheckMark Software now has a Windows version of its Macintosh accounting and payroll programs. CheckMark Payroll for Windows ($129) can calculate employee records; determine federal, state, and local tax responsibilities; and print W-2X and 941 tax reports. 800-444-9922, 303-225-0522.

Hi-Tech Advisers has come out with Version 4.0 of The Hi-Tech Accounting

NEW

Lexmark Printers Let You Know What's Going On

Solving network printing problems usually means you have to walk to the printer to find out what's going on, but with a new module that includes a printer utility called MarkVision, **Lexmark International** has made that walk unnecessary. Using a Windows workstation, you can access printer drivers and other printer utilities, change settings on the printers as if you were standing next to them, and be notified of any problems as they occur. The package also has a Quick Setup feature which stores configurations for distribution and lets you create macros to download to flash memory. The new module is standard on all printers in the 4039 plus line. Alternatively, an upgrade module is available for $359 to turn you current 4039 into a 4039 plus.



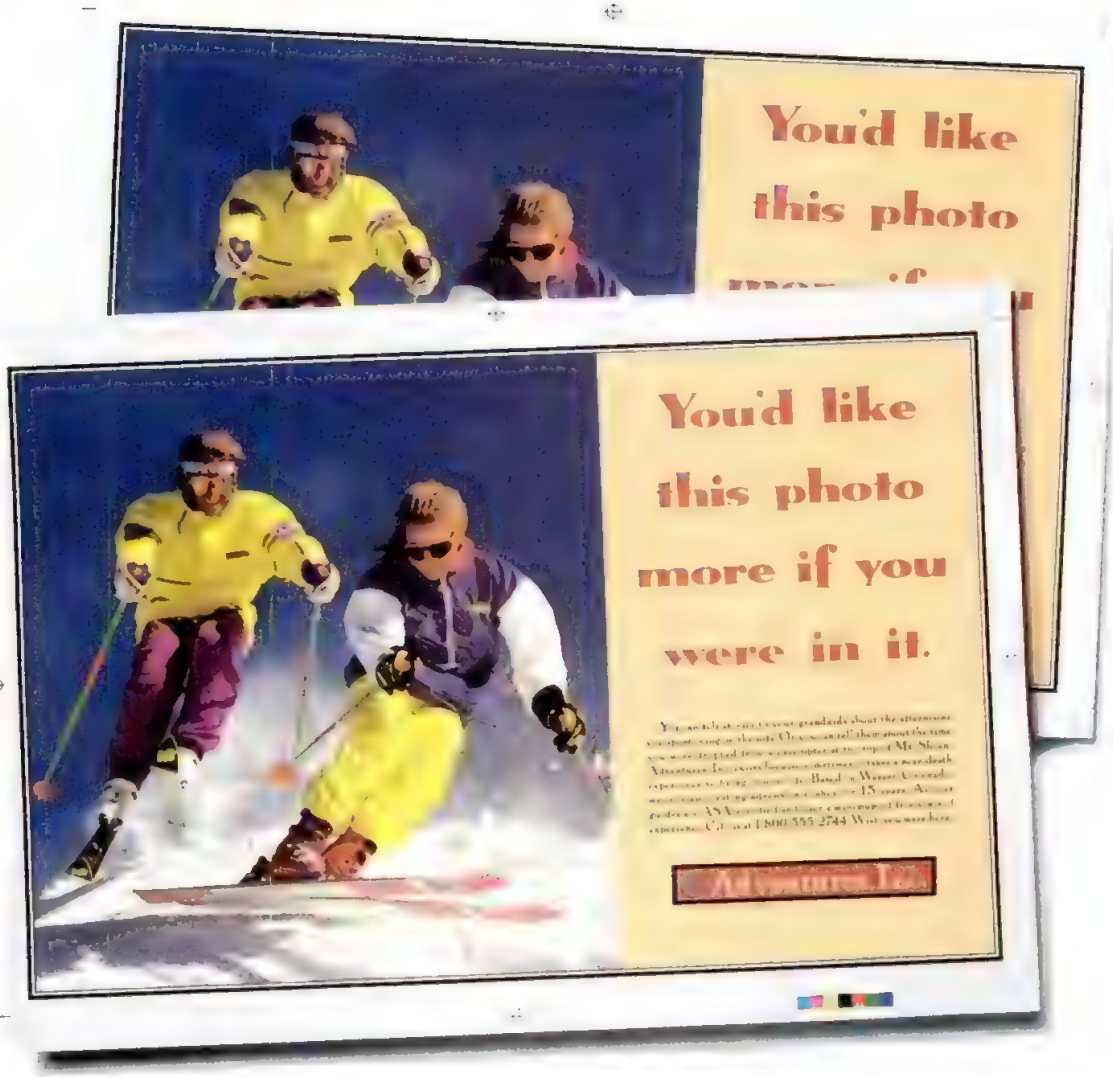
Using Lexmark's MarkVision printer utility is easier than walking over to the printer.

▶ **Lexmark Laser printer 4039 12R plus.** List price: *$1,749.* **4039 12L plus.** List price: *$2,299.* **4039 16L plus.** List price: *$3,399.* Lexmark International Inc., *740 New Circle Rd. NW, Lexington, KY 40511-1876; 800-358-5835, 606-232-2000;* fax, 606-232-2380.
Circle 414 on reader service card.

NEW

Accelerator Card Gets Your PC Ready for Windows NT

The folks at **ShaBlamm! Computers** claim that their latest accelerator card can run Microsoft Windows NT six times faster than a 486DX2/66 and three times faster than a 66-MHz Pentium system. The NiTro-VLB Windows NT Booster, specifically designed to process Microsoft Windows NT's multithreading features, requires a VESA local-bus motherboard. The card is available with either a



One of these is a color proof and one is output from our new printer. We forgot which is which.

We paid $70 and waited three days for one of these. The other popped out of our new Tektronix Phaser™ 480 in minutes. Pull out your loupe and start guessing. And while you're down there staring, note our output's phenomenal color. PANTONE®-approved, it's perfect for matching those tricky product colors, logos and skin tones. You might also notice the full 11" x 17" print area. Yes, Virginia, there are tabloid-sized full bleeds. And it shares easily: the Phaser 480 is a work group printer for Macs, PCs or workstations. Plus, it boasts a powerful RISC processor and true Adobe® PostScript™ Level 2. Spread-sized bleeds? Reprint quality comps? Pre-film proofing right at your desk? Welcome to preproduction heaven. So head down to your nearest Tektronix dealer to see for yourself. And by the way, our guess is that the one on the bottom is our print. Well, then again ...

Tektronix

For a free print sample or dealer location call 800/835-6100, Dept. 32E.

Phaser is trademark of Tektronix, Inc. All other marks are trademarks or registered trademarks of their respective companies.

CIRCLE 001 ON READER SERVICE CARD

100-, 133-, or 150-MHz MIPS Orion R4600 processor, has 16MB of 15-ns TrueCache memory (expandable to 64MB), and ships with Microsoft Windows NT and a ShaBlamm! installation utility.

▶ **100MHz NiTro-VLB Windows NT Booster.** List price: *$1,995.* ShaBlamm! Computers Inc., *21040 Homestead Rd., #201, Cupertino, CA 95014; 800-648-7685, 408-730-9696; fax, 408-730-4940.*

Circle 415 on reader service card.

NEW

Dabbler Gives Novice Artists Their First Canvas

Fractal Design Corp., vendor of the well-known $399 Fractal Design Painter, has released a more accessible painting and drawing program called Dabbler. The 16-bit color drawing program has simplified versions of the tools found in Painter, with an emphasis on ease of use. Everything centers around a tool drawer interface where you point and click to open

Dabbler stores all 54 drawing tools in one "drawer".

and close drawers and select drawing instruments, paper styles, and editing features. The package has 54 drawing tools, 20 different paper textures, and even some photo-retouching tools. There are also animated examples of basic techniques and an illustrated manual to get you started.

▶ **Fractal Design Dabbler.** List price: *$99.* Fractal Design Corp., *335 Spreckles Dr., Aptos, CA 95003; 800-297-2665,* 408-688-5300; fax, 408-688-8836.

Circle 416 on reader service card.

IMPROVED

Mustang Updates BBS Software

A lot has changed in bulletin board systems since **Mustang Software** released Version 3.0 of WildCat! three years ago. WildCat!, Version 4.0, helps system operators stay competitive by offering a faster system with more features and increased capacity. The new release can be accessed by the new V.Fast Class modems and includes features such as support for chat sessions and a spell-checker for the on-line message editor. It also lets you preview images in thumbnail sizes prior to downloading. You may want to change the look of your BBS because the package now supports over 30,000 conferences and has a new scripting tool for greater flexibility in the systems design. Your users will also appreciate the ability to write longer messages (up to 888 lines).

▶ **WildCat!, Version 4.0.** List price: Single-line BBS, $129; 250-line or more BBS, $799. Mustang Software Inc., *6200 Lake Ming Rd., Bakersfield, CA 93306; 800-873-2500,* fax, 805-873-2599.

Circle 417 on reader service card.

IMPROVED

CrystalGraphics Brings Text to Life

Thanks to **CrystalGraphics'** Crystal Flying Fonts, Version 2.0, your presentations can now include logos and titles with custom designed 3-D text creations that move around the screen. The DOS-based package is built on CrystalGraphics' rendering engine but has been simplified for dealing specifically with text objects. Version 2.0 gives you several new features, such as more predefined animation paths, the ability to select and change individual objects in a group, and a faster beveling capability with more beveling styles. The package ships with a CD-ROM of background pictures, texture maps, and animation paths for you to use.

▶ **Crystal Flying Fonts, Version 2.0.** List price: *$195.* Upgrade pricing: *$99.* CrystalGraphics Inc., *3110 Patrick Henry Dr., Santa Clara, CA 95054; 800-979-3535, 408-450-0210; fax, 408-496-0970.*

Circle 418 on reader service card.

Crystal Flying Fonts lets you put your words into 3-D motion.

BRIEFS

Low-Cost Accounting Software

Series. The new version has three modules: Accounts Payable, General Ledger, and Accounts Receivable, each priced at $69 ($169 for all three). The Hi-Tech Accounting software works with PCs and has new features such as the ability to compare budget figures with figures from the General Ledger and more flexible output to printers and printing styles. 800-882-4310, 518-756-3800.

Software Store Products' DOS-based program for small businesses uses only 512K of RAM and can operate on a 286-based system. The Invoice Store, Version 3.1 ($95) is comprised of four modules: Maintenance, Invoicing, Receivables, and Reporting, which covers basic customer tracking, payment records, and invoice creation. 516-244-6927.

AND FINALLY...

Novell is extending its NetWare 4 sales promotion; customers who purchase and register NetWare 4 by December 31 will receive updates and upgrades free of charge through March, 1995. . . . **U.S. Robotics** has reduced the prices of its WorldPort PCMCIA 14.400-bps modems by 40 percent. Prices now start at $339. . . . **Phoenix Technologies** has lowered the price of Eclipse FAX with OCR from $129 to $84.95. . . . The price of the JX-325 color flatbed scanner from **Sharp Electronics Corp.** has dropped 28 percent to $999. . . . **Agfa** has slashed the price of FotoTune 1.03 in half, to $395. . . . **Individual Software** has announced it will be bundling Professor Multimedia, a CD-ROM training program for multimedia technologies, with **Aztech Systems'** sound cards. . . . The **Telecommunications Industry Association** has created the Multimedia Engineering Subcommittee named TR-41.5, which will concentrate on the deployment of multimedia in the residential and commercial worlds. . . . **Cirrus Logic** has a new chip called the CD-MD141BA (scheduled to ship starting in August) that combines the functionality of a data and fax modem with a sound card.

System-Saving Upgrades.

POWER SUPPLIES

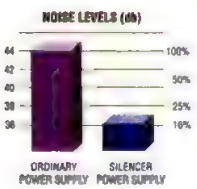
"The premier power-supply maker"
John Dvorak, *PC Magazine*, March 30, 1993
"The only company to go to for a power supply"
Jerry Pournelle, *Byte*, April 1993

ENERGY-SAVING UNITS

Save electricity with our economical Energy-Star power supplies. Fully-tested and UL/CSA/TUV approved, they're perfect for standard systems.

STAR 205 SLIM/DESK/TOWER $79

ULTRA-QUIET UNITS



Unrattle your nerves with an ultra-quiet **Silencer** power supply. Appreciated by users **since 1986**, their high-efficiency fans and low-turbulence circuitry reduce noise by up to 84%! A must for home office or *multimedia* applications.

SILENCER 205 SLIM $109
SILENCER 220 DESK/TOWER $119
SILENCER 270 DESK/TOWER $179

HIGH-PERFORMANCE UNITS

Upgrade your computer with one of our premium **Turbo-Cool** power supplies—the choice of PC professionals. You'll get 50% - 100% more power, built-in line conditioning, super-tight regulation, ultra-clean output, a high-capacity cooling fan, UL/CSA/TUV, a 3-year warranty for 300W models, and a **5-year warranty** for the 450! Ideal for high-end workstations and network file servers.

TURBO-COOL 300 SLIM/BABY $169
TURBO-COOL 300 DESK/TOWER ... $189
TURBO-COOL 450 DESK/TOWER ... $349

SOLID-STEEL CASES

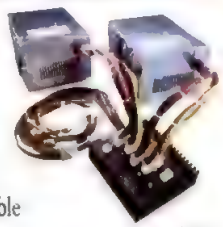
Give your computer a professional, high-tech look with one of our premium-quality, **USA-made**, all-steel cases. They're rigid—unlike light-weight imports—so the PC's components are always properly aligned and grounded. You'll enjoy easy system access, and with room for up to **18 drives**, there's real expandability!

	Desktop	Tower	Monster
Exposed Drive Bays:	5	6	13
Total Drive Bays:	7	8	18
Motherboard Capacity:	1	1	2
Power Supply Capacity:	1	1	2
Cooling Fan Capacity:	2	3	6
Filtered Air Inlet:	Yes	Yes	Yes
Lockable Front Door:	Yes	No	Yes
Beige or Black Finish:	Yes	Yes	Yes
Meets FCC-B Specs	Yes	Yes	Yes
Made in USA	Yes	Yes	Yes

SOLID-STEEL DESKTOP CASE $175
SOLID-STEEL TOWER CASE $295
SOLID-STEEL MONSTER CASE $895

REDUNDANT POWER

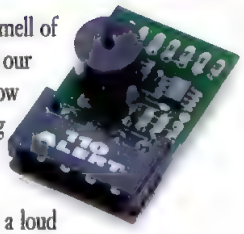
Eliminate the risk of network downtime or data loss due to power supply failure with the **TwinPower 900** redundant power system. It delivers high-capacity, fault-tolerant power to your entire network server. Consists of two **Turbo-Cool 450** power supplies in parallel, utilizing a special power-management interface module. A must for *mission critical* LANs.



- 900 watts peak power
- 100 X more reliable than a single-unit
- load-sharing design
- hot-swap capability
- 5-year warranty
- monster-case compatible

TWIN-POWER 900 ..... $995

OVER-TEMP ALARM



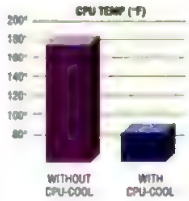
Don't wait for the acrid smell of burnt components! With our new **110 Alert**, you'll know if your PC is over-heating *before* damage occurs. Should the computer's temperature reach 110°F, a loud alarm warns you that a fan has failed or that the cooling system is inadequate to handle that extra hard drive or other peripheral you may have added. Compatible with any computer, the inexpensive **110 Alert** is compact, easy to install, and so reliable, it carries a lifetime warranty.

110 ALERT $19

CPU COOLERS

It's a fact. 486 chips run hot, often exceeding 185°F! Now, you can cool your 486 to a safe 85°-95°F with our popular **CPU-Cool**. It prevents random system errors and other heat-related problems. Consists of a mini-fan embedded in a die-cast heat sink that easily mounts on the CPU. Powered by a spare drive connector. Effective, inexpensive insurance!

- cools CPU 70° - 100°F
- prevents system errors
- adds years to CPU life
- thinner, quieter, and better-built than cheap imported imitations.
- safe, simple installation



CPU-COOL (FOR 486s) **$24**
PENTACOOL (FOR PENTIUMs) **$29**

PC POWER & COOLING, INC.

5995 Avenida Encinas, Carlsbad, CA 92008 • (619) 931-5700 • (800) 722-6555 • Fax (619) 931-6988

We accept Visa, MC, COD, or PO on approved credit. Warranty period: Five years for Twin Power and Turbo-Cool 450. Three years for Turbo-Cool (except 450). Two years for all others (except 110 Alert). Hours: 7 a.m. - 5 p.m. (PT) Mon. - Fri. Silencer, Turbo-Cool, TwinPower, CPU-Cool, PentaCool, and 110 Alert are trademarks or registered trademarks of PC Power & Cooling, Inc. ©1994 PC Power & Cooling, Inc.

CIRCLE 080 ON READER SERVICE CARD

---Funny how it's the little things that attract people to a particular small business server.

Then again, maybe this is a big thing.

Introducing the

IBM PC Server, for small business.

486DX 66 MHz
or Pentium® 60 MHz

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Upgradeable

▪

30-day money-back guarantee

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*3-year on-site warranty**

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Tested to exacting IBM standards

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Industry standard architecture

▪

*Starting under $3,000***

You're about to place your entire business in a box no bigger than a suitcase. That's enough to make anyone pace the floor.

Fortunately for the life of your carpet, IBM now makes a server for small local networks.

This means, of course, that the kind of performance and reliability IBM is famous for, and the kind of support we're famous for (24 hours a day, 7 days a week, 365 days a year†) are now available to you, too.

All at the kind of price (we confess) IBM is not so famous for. A remarkably competitive price, whether you need to network five people or fifty.

And because the IBM PC Server is easily upgradeable, and happily works with most anyone's peripherals, it lets you create the perfect, total business solution.

For more details, talk to your favorite reseller, or, if you need a favorite reseller, just call us at the Personal Systems HelpCenter® at 1 800 772-2227.†† For information via FAX, call 1 800 IBM-4FAX and ask for document 3078.

IBM®

**Copies of IBM's statement of limited warranty are available upon request. **Dealer prices may vary. †Via telephone from the Personal Systems HelpCenter. ††In Canada, call 1 800 465-7999. IBM and HelpCenter are registered trademarks of the International Business Machines Corporation. All other trademarks and registered trademarks are the property of their respective holders.* *© 1991 IBM Corp.*

All the hell-bent

FURY

of Hurricane

TIFFANY.

Without the costly

GOVERNMENT

cleanup.

THE WINDS are whipping into a frenzy and your senses are jamming on a brand new frequency. You're in the eye of Sound Blaster,™ where all the hottest games and software are made to be played. Sound Blaster sound cards set the sound standard. And with Sound Blaster 16 SCSI-2™ and Sound Blaster 16 MultiCD,™ you get 16-bit super-realistic audio quality. So, call 1-800-998-5227 and crank up your wildest CDs or venture into the hurricane from hell. But if it gets too heavy, be prepared to evacuate.

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Wake up the rest of your brain.

CIRCLE 086 ON READER SERVICE CARD

Read Only

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Edited by Tin Albano

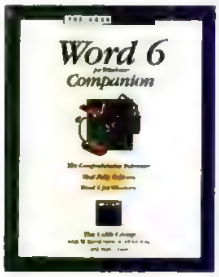
Word and WordPerfect: Giant Books on Giant Programs

BY EDWARD MENDELSON

As word processors get more complex, their help screens and manuals often struggle to cover the details. The best books on programs such as Microsoft Word for Windows, Version 6.0, and WordPerfect for Windows, Version 6.0, aren't paraphrases of the manuals but rather full-featured supplements that tell you secrets you won't learn in the main manual and help files. Here are the two most comprehensive books on each of these major Windows word processors.

MICROSOFT WORD FOR WINDOWS 6.0

Microsoft Word for Windows, the most elegant of all PC-based word processors, seems to inspire authors to write the most informative books and word processing programs. If you have to choose one book from the large shelf of excellent books about Word, your best choice is either *Word 6 for Windows Companion*, by The Cobb Group, M. David Stone & Alfred Poor and Mark Crane, $29.95; Microsoft Press, 800-677-7377. ISBN: 1-55615-575-1.



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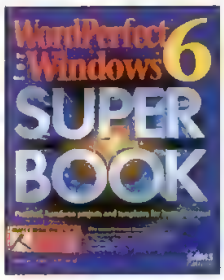
▶ **Word for Windows 6 Super Book,** *by Herb Tyson, $39.95 (includes disk);* Sams Publishing, *800-428-5331. ISBN: 0-672-30384-1.*

intelligent enough to want to use Word efficiently, even if you've never used it before. The book immediately makes clear that Word is designed to be customized and personalized, and that you don't need to be an expert to use its file-management, security, and network features. Almost every page has a highlighted tip on the subtleties of Word's procedures. These range from the program's rules for selecting or counting words to powerful keyboard shortcuts normally deeply hidden in the help file and manual. This is the best book for anyone who wants to become a Word expert effortlessly and enjoyably.

No matter how expert you are in Word, you're certain to learn something from *Word for Windows 6 Super Book*, a thousand-page encyclopedia of tips, procedures, and warnings. No hidden feature or annoyance is too abstruse for detailed coverage. When Word won't let you deselect a field with the same keystrokes you used to select it, or when a menu option doesn't work exactly, explains the problem and tells you a way to work around it. No single book contains every known fact about a program as complex as Word, but this one comes closer than anything else.

WORDPERFECT 6.0 FOR WINDOWS

The best books on WordPerfect for Windows are not as good as the best books on Microsoft Word. Many current WordPerfect books are marred by errors because their authors failed to notice changes from earlier versions and subtle differences between the DOS and Windows versions. The two best current WordPerfect books are *WordPerfect 6 for Windows Super Book*, by Marilyn Horn Claff et al., and the more concise *Using WordPerfect Version 6 for Windows, Special Edition*, by the Que Development Group.



WordPerfect 6 for Windows Super Book, like *Word for Windows 6 Super Book*, is a cornucopia of techniques, warnings, and workarounds for bugs, with a clear summary of network installation—a subject virtually ignored in other books. The chapters on macros are the most detailed in any all-purpose book on WordPerfect. And this is the only book Perfect's "smart quotes" work correctly. The book also has the first printed documentation of WordPerfect's automatic ligature-substitution feature—although the book fails to mention that the feature doesn't work in the current version.

In earlier editions, *Using WordPerfect Version 6 for Windows, Special Edition*, was the most comprehensive of all WordPerfect books. It's thinner now and omits many details found in *Super Book*, but it still has the clearest exposition of both basic and advanced features. The book is the work of multiple authors, yet its style is consistently clear and it never skimps on explanations of the features it includes. If you don't need the advanced detail of *Super Book*, this is the best general desktop guide to WordPerfect.

▶ **Word 6 for Windows Companion,** *by The Cobb Group, M. David Stone & Alfred Poor and Mark Crane, $29.95;* Microsoft Press, *800-677-7377. ISBN: 1-55615-575-1.*

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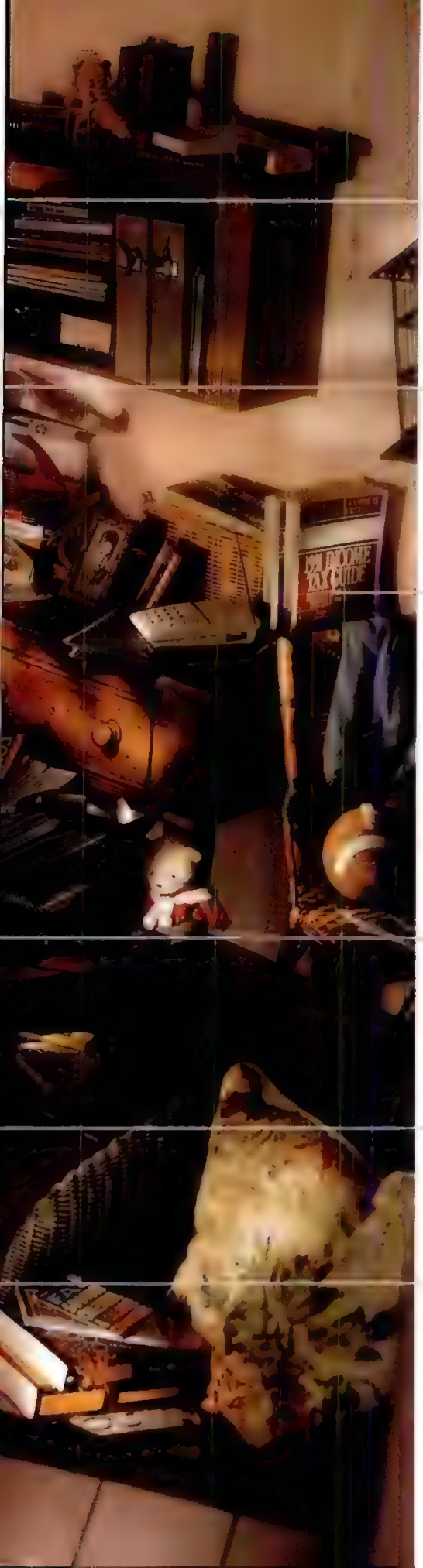

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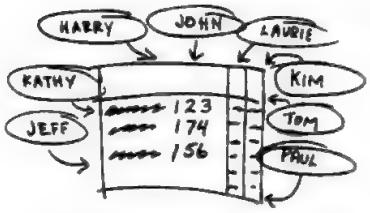

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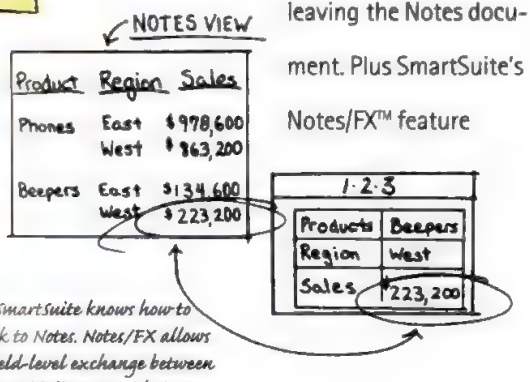

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Michael J. Miller

Big PCs for Little Rascals

Parents love to tell stories about their kids. And PC users love to talk about technology and the computers they use. So it's only natural that wherever I go, I hear stories about computers—particularly about how children are using computers. Computing at home has gotten a lot more interesting in the past year or so, due primarily to the growing prevalence of faster machines, CD-ROM drives, and continually improving education and entertainment software. Home computers once were used mainly for work brought home from the office or for games, but now many of these home PCs are being used by children.

Hey, I'm not immune. I get a real rush watching my three-year-old daughter discover new ways of using the computer. She learned how the letters she types on the keyboard show up on the screen. (Microsoft Word for Windows is now "The Word Game.") She learned how to move the mouse around. She learned how to click on the things she wants to click on.

Programs like Disney's Mickey's ABC's and Alphabet Blocks were great when she was learning her letters. Broderbund's amazing Just Grandma and Me and Arthur's Teacher Troubles helped her learn how to control the mouse. The Learning Company's Math Rabbit grabbed her attention for months and helped her learn her numbers and basic concepts like addition. The Waterford Institute's Rocky and Rosy Learn to Read and Edmark's Bailey's Book House are current favorites; she even used Bailey's Book House to create Valentine cards for her classmates.

PARENTS ON KIDS & COMPUTERS

Other parents tell similar stories. Our editor, Robin Raskin, who probably knows more about kids' software than anyone, tells how her children produced such fancy-looking reports that their teachers thought their parents were doing their homework. But Robin's kids just used CD-ROM–based encyclopedias and the like, along with the powerful though common layout features found on today's most popular word processors.

Bill Howard, an executive editor of *PC Magazine*, tells about how his three-year-old son is entranced by all the songs in 7th Level's Tuneland.

David Herbick, our art director, recently brought a PC with a big monitor to his daughter's preschool so he could demonstrate how computers are used to create drawings. I bet David's performance would have been a big hit with his daughter's schoolmates a few years ago, but these jaded kids met his demonstration with yawns.

The reason for the less than enthusiastic reaction? Most of the kids probably already had a certain degree of exposure to computers or even had access to similar systems at home, where they could play with programs like Broderbund's Kid Pix. Such programs have made drawing on computers commonplace for children. Davidson's KidCAD even helps them build houses and towns.

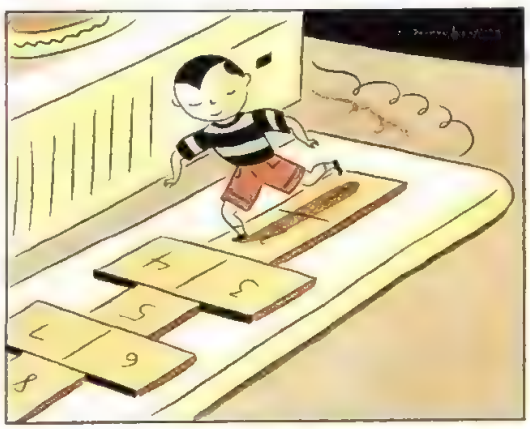
WHOSE PC IS THIS ANYWAY?

Educational software can really draw kids to the PC. It's amazing to watch. Of course, this has led to questions that our parents never had to answer, such as

- "Is it a problem if the baby spits up on the keyboard?"
- "Mommy, can I get a 486 and a CD-ROM drive for my birthday?"
- "Daddy, what's a General Protection Fault?"

Despite the occasional tough question, I'm convinced that using computers can be simply wonderful for our children.

To begin with, computers make learning fun. Whether it's learning letters or numbers, learning to read, or looking things up electronically, computers make it fun. The look of wonder on our children's faces when they learn something is very special. When they're using computers, kids don't distin-



There's never been a better learning tool. Kids and computers were made for each other.

Illustration by Michael Klein

guish between learning and playing—and that's the way it should be. With computers, children can also progress at their own pace, doing what they want when they want to. Again, that makes learning more fun.

LOOK AT IT THIS WAY

Computers are also opening up new ways of looking at information. With CD-ROM–based software, children can look at everything from dinosaurs to musical instruments to underwater creatures. Yes, you could get books with similar information, but they'd just have regular old pictures. Electronic CD-ROM books have moving images and audio accompaniment, adding a whole new dimension to books. Videos, of course, have sound and motion, but they aren't browsable; you have to move through them in one direction. Computer software is interactive, and this makes it more interesting and much more fun.

Perhaps most important, computers may very well change our whole approach to learning and the way we gather information. With CD-ROMs and the continuing growth of on-line services, the amount of information available to our children will be practically limitless. So skills such as learning the right questions to ask and learning how to search through information will become more and more important.

What our children will expect from their schools, and from their jobs in the future, will be very different. They won't be afraid of technology; they will likely feel as comfortable with the Internet or its successors as we do with the television networks. They'll expect interactive, multimedia information at every stage of the game. They'll expect information and technology to change even faster than we do.

PCs CAN'T DO IT ALONE

Computers alone won't prepare our children for this future. They still need traditional schools and activities. But schools have to change to meet our children's expectations and adapt to this new technology. They'll have to be more computerized. As more and more kids get access to computers at home, they will expect to find the same kind of learning tools at school.

Schools will have to become more flexible as kids learn to work at their own pace and on their own projects. And they'll have to focus more and more on teaching how to analyze information, rather than on just the raw information itself.

It's true that most children in our society don't have such computers and software at home today, but that's a short-term phenomenon. With the current rate of decline of prices, eventually a basic computer with a CD-ROM drive shouldn't be that much more expensive than a good color television—and today just about everyone has a TV.

It does mean a new way of looking at the world. Just as radio changed the world for our parents, and television changed the world for many of us, computers will change the world for our children. We don't know exactly how far-reaching this change will be, or what it all really means for the future, but I'm encouraged by the fact that computers are inherently an interactive medium. You don't just want to sit there and watch the screen, you want to manipulate the images you see. Our children may become computer hackers, but at least they won't become couch potatoes. □

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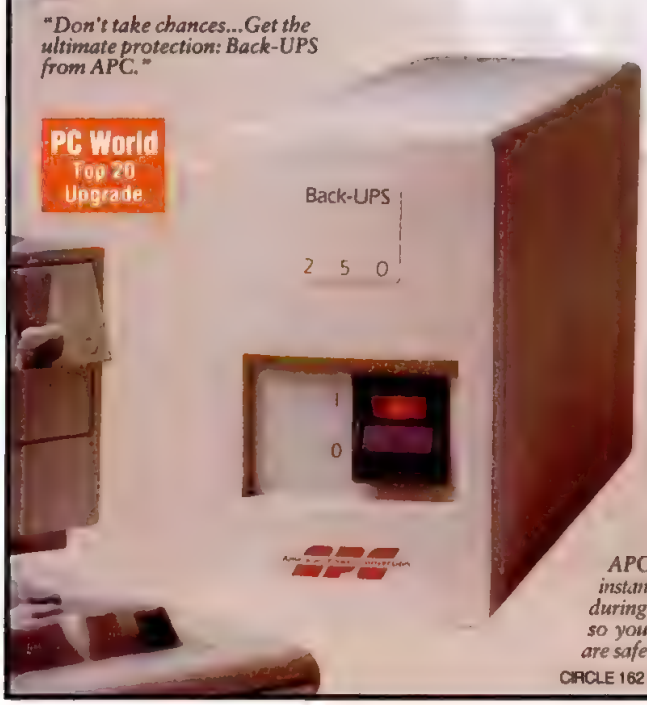

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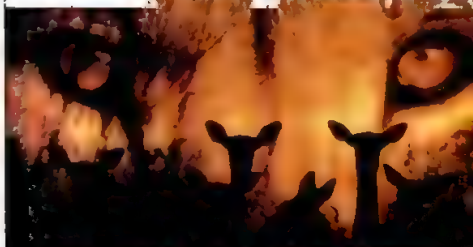

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CIRCLE 272 ON READER SERVICE CARD

Bill Machrone

Eyes on the Prize

The poem below was written on a PC. By a man in bed. By blinking his eye. His name was Ed, and he was dying of ALS—amyotrophic lateral sclerosis, also known as Lou Gehrig's disease. The PC was his only means of self-expression. He was imprisoned in his body—senses, thoughts, and memory intact—unable to move or make a sound.

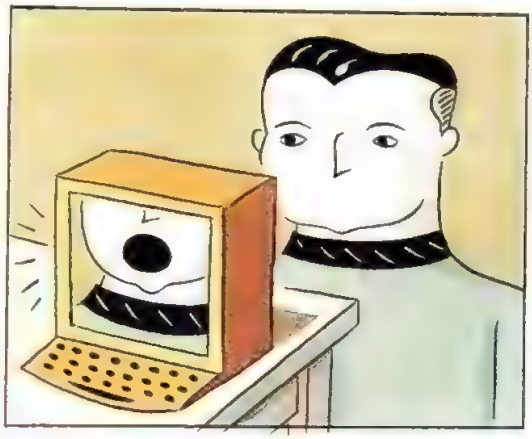
Every morning in Africa, a gazelle wakes up.
It knows that it must run faster than the fastest lion,
Or it will be killed.

Every morning in Africa, a lion wakes up.
It knows that it must outrun the slowest gazelle,
Or it will starve to death.

It doesn't matter whether you're a lion or a gazelle.
When the Sun comes up in the morning, you'd
better be running!

Ed had the computer because some people at a PC user group cared enough to volunteer their time and expertise to design and configure the equipment, train him to use it, and give him the ongoing support he needed. The effort started with Joanie Margaitis, who died of ALS in 1991. Joanie's ALS started with slurred speech, and she rapidly lost the ability to speak as her motor nerves deteriorated. Her friend, Shirley Fredlund, went on a yearlong search for the technology that could give Joanie her voice back. By the time she'd found it, Joanie had died. Shirley invested what she had learned into Voice for Joanie, a volunteer organization sponsored by the Danbury (Connecticut) Area Computer Society and the New Milford Hospital Foundation.

VFJ has placed more than 30 systems and has helped 54 people with disabilities. Some, who have use of their hands, "speak" through text-to-speech programs and voice synthesizers. Others, like Ed, use infrared sensors to detect the motion of their eyelids. They blink to navigate through menus of options, common words and phrases, and letters of the alphabet. If that sounds like a difficult way to communicate, consider the alternative. Instead, someone like Ed is now able to interact with friends and relatives as well as record his inner thoughts and feelings. Members of the user group help in various ways. Some work directly with the participants, customizing the systems to their needs. Others work with vendors, and some work on the technology, programming, and integration.



PCs extend the REACH of volunteer organizations, rewarding those who give and those who receive.

SCHOOL TIES

Senior citizens in the retirement community of Green Valley, Arizona, have spent thousands of hours since 1990 at the nearby Sahuarita Elementary School. They're not attending class. They're helping hundreds of kids each year come to terms with technology. They run the school's computer lab and work closely with the teachers to incorporate computers into the everyday curriculum. Green Valley has a population of 18,000 and countless clubs and activities for its residents. The computer club, with 748 members, is the largest group, and its involvement with the school's computer lab is the most satisfying thing some of its members have ever done.

The blending of the school's needs, the retirement community's dedication, the generosity of local businesses, and the administration's support appears utopian. In truth, it belies a lot of hard work and commitment on the part of people who believe in the kids and their need for a high-tech component to their education.

PIONEER SPIRIT

Project Knee-High has a lofty aim: Cut computers

Illustration by Michael Klein

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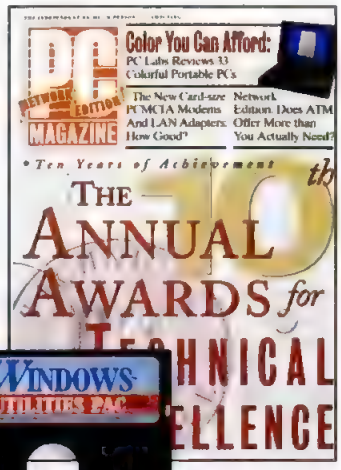

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Bill Machrone

down to size for kids. The world is still roughly divided into camps of haves and have-nots, and nowhere is the difference between them more apparent than when you look at who has access to technology. If your parents or school can't afford computers, will you ever get the exposure that could make all the difference in your life?

The Pioneer Valley Computer User Group, working with the Westfield, Massachusetts, Boys and Girls Club, have answered this question eloquently. Together they run an after-school program that transcends latchkey programs and the typical after-school environment. Members of the user group conduct classes in math, reading, science, report writing and research, newspaper reporting, writing and design, computers, and good old DOS. They even run an occasional seminar on how to build your own PC, but the kids learn more than just how to connect and configure. When they recently finished a system, they decided to give it to Josue, an autistic club member. At last report, Josue was responding well to the classes.

These endeavors have something in common beyond the thread of community service. They're all winners of the 1994 REACH award, a program cofounded by Ziff-Davis Publishing Co. and the Association of PC User Groups. Sponsors of individual awards—IBM PC Co., Microsoft, Panasonic, and Ziff—will grant these winners $15,000 each to continue their good works.

Voice for Joanie will use the money to acquire more voice-synthesis hardware and better input device technology to help even more people afflicted with ALS, MS, and paralysis. The Computer Club of Green Valley has earmarked the funds to acquire new machines for the computer lab, which will free up older machines for the classrooms. It will also purchase a professionally written English-as-a-second-language learning program. Project Knee-High will extend its technological range by networking some of its machines, adding more software, a file server, and a couple of CD-ROM upgrade kits.

As heartwarming as it is to read about these successes, it's infinitely more rewarding to get involved. The people in these organizations and hundreds of others are giving their precious time, knowing that their investments are paying back immeasurably by improving the quality of others' lives. □

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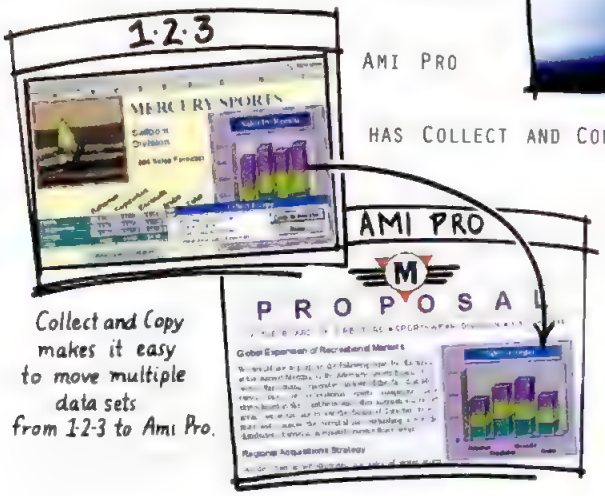

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CIRCLE 038 ON READER SERVICE CARD

John C. Dvorak

Sex On-Line: Shhhhh, It's a Secret

The reason that on-line services are popular has a lot more to do with virtual matchmaking and sexy chit-chat then with anything else. Nobody wants to admit it, but the more anonymous and sexually explicit the service, the more successful it is. It's a dirty secret nobody wants to discuss.

Before I go on, let me say that I'm not necessarily objecting to any of this (I'm no prude). It's just interesting to me that the American public at large and the Information Highway–crazed news media don't have a clue as to what's going on.

As a disclaimer, I should say up front that all the on-line services have many important functions. Okay? But for years, one of CompuServe's biggest money-makers has been its CB chat sessions, in which you chat (type, actually) anonymously. You can join the CB Simulator and assume a name such as Don Juan or Mr. Big Stuff or Lois the Hooker (be you male or female) and chat with all sorts of people. It's all virtual and nobody is certain whom they're talking to. You can go into private virtual "rooms" and exchange phone numbers, promise to meet, agree to do lewd things, exchange photos.

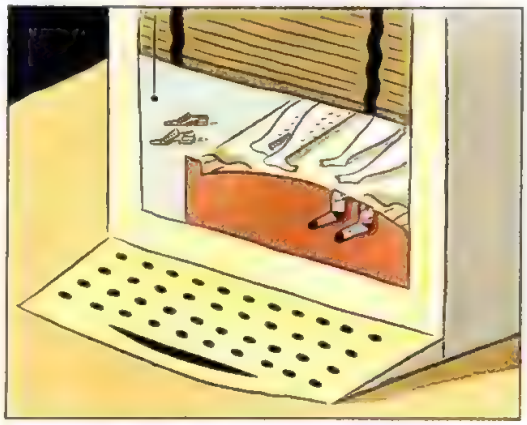
It's pretty tame and seems fairly harmless. The chance that an old pederast could get the home phone number of a preteen is as unlikely as it is in the real, non-virtual world. The fuss made over the threat of hopeless pedophiles using on-line services to meet kids ignores the reality of on-line chatting. There are thousands and thousands of people doing it every minute. CompuServe has CB Simulator, GEnie has a chat system, and America Online (AOL) has something called the People Connection. There are hundreds of bulletin boards specializing in on-line chatting, and the Internet is totally out of control with its Internet Relay Chat (IRC) system. There's the potential for weirdness, of course, but true scandals are rare.

While there's no evidence that the majority of on-line chatting is about sex, the systems that encourage open anonymous sex chatting are the most successful. The overwhelming success of AOL supports this assertion. I'd argue that the least successful "big" on-line service is GEnie, where your core ID is usually your last name. I go into the chat sessions and I'm DVORAK, which, I think you would agree, severely limits the amount of on-line fun I can have. With CompuServe, you're given a number out of a hat. You choose a "handle" when chatting—maximal anonymity. AOL encourages people to add extensive personal profiles accessible by keyword searches. You can do a search on just about any sexual habit or wacky orientation imaginable, and you'll find a slew of people—men and women—who list themselves as aficionados begging to be chatted with or sent mail.

This is completely fascinating to anyone with any curiosity at all. So you might spend hours dreaming up odd keyword searches to see what you can find. Of course, this all takes time (especially on AOL, which is incredibly sluggish at peak hours) for which you're charged money.

The future for on-line chatting is rosy. During the peak hours on CompuServe the chat system is full and will reject you when you try to get on. AOL has so many people chatting that it's almost impossible to count them. Nationwide chat-only BBSs such as the Garbage Dump are doing a great business. And the Internet has a phenomenal on-line chat audience with people discussing sex and politics more than anything else.

This is a sociological trend that needs closer study. Is there some secret need for this lurking in our collective unconscious? I think it's time some sociologists take a close look and tell us what it all means. I'd like to know!



Thousands and thousands of people are doing it every minute, but it's a dirty secret nobody wants to discuss.

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CIRCLE 325 ON READER SERVICE CARD

John C. Dvorak

Inside Track

Report from Tel Aviv Dept.: Israel seems to have more high-end engineering design centers than any country outside of the U.S. The new **Pentium** designs using the 0.6-micron process to create the 100-MHz 3.3-volt part came out of the Intel Design Center in Haifa. The engineers there are not too specific about the **next-generation Pentium,** but casual conversation indicates it'll be 150 MHz.

Years ago, Intel set up shop in Haifa centered around the inventor of EPROM. National Semiconductor and others followed soon after. Uri Weiser, chief of the **Pentium division,** told me he believes that the natural bluntness and frankness of Israeli engineers is conducive to high-end microprocessor design, where **excessive kibitzing** actually minimizes bugs in final designs. An interesting concept. Whatever the case, the Haifa region is known for quality products.

Engineers at IBM's Haifa Research Center have developed a DSP that's 100 percent software. The code can be ported to any chip and used as a virtual on-board DSP that does real-time manipulation of voice.

At IBM's Haifa Research Center, a team of engineers has developed a **DSP code-named Freedom.** They showed this programmable digital signal processor as a MIDI system **capable of playing 32 32-bit voices** simultaneously. The most interesting thing about this DSP is that it's **virtual—100 percent software.** The engineers say that the PowerPC 601 is designed in such a way that it can act as a DSP and needs no coprocessor for DSP chores if one uses the IBM code.

Apparently, the code can be ported to **any microprocessor** and used as a virtual on-board DSP. I'm told that the PowerPC is the most efficient. The system uses "plug-ins" to **exploit** the underlying engine. I saw an add-in for **real-time manipulation** of voice that could turn a lady's voice into a **slow-talking man's** or whatever you wanted. Hot stuff. One of the IBM engineers admitted that the **unfortunate aspect** of this development is that Apple (with its Power Mac) is more likely to buy into it than IBM.

This reminded me of a **conversation I had with an IBMer** concerning IBM's continuous-speech voice recognition software.

Dvorak: "How are you going to sell the product?"

IBMer: "We want to use it for command and control, cursor movement, menu pull-downs, stuff like that."

Dvorak: "A mouse is easier to use. Why do that? I'd like something to take dictation. I could feed it notes, tapes, whatever. I could dictate a whole book. Anything."

IBMer: "You really think people would want that?"

No kidding; it really happened.

Consulting a Psychic Dept.: I was watching the "Psychic Hotline Show" at 4:00 A.M. the other day and decided to call in to find out if a **TV psychic** can tell me about Microsoft's plans for the future. I was **shocked** by what I was told. None of the following is true, of course. The project is code-named "Scorched Earth." The idea is to **put every Microsoft application** (PowerPoint, Access, Word for Windows, FoxPro, Project, Excel, Bookshelf) onto a single CD-ROM for $99. This project will take place when the market for CD-ROM drives reaches 10 million units. Microsoft wants to sell to 40 percent of the market, about $1.5 to $2 billion worth of CD-ROMs. With a six-month update period, the company would lock up the market with sales of $3 to $4 billion a year. It would also **lock up the CD-ROM,** since the documentation would be on-line and the apps would optionally run directly off the CD-ROM to preserve hard disk space.

Needless to say, with only 4 million CD-ROM drives in place, the **Scorched Earth plan** is far into the future. By that time, each of the Microsoft apps will be **so bloated** that maybe only one or two would fit on the 660MB available on the CD-ROM. Meanwhile, Microsoft is **flooding insiders** and corporate pals with a CD-ROM containing the latest version of Windows 4 (code-named Chicago). Users are very positive about one particular version of the new desktop—the one that **looks just like a Macintosh!** Ten years after the introduction of the Mac, PC users get the same interface. Sheesh. Is this progress?

Genuinely Interesting Magazine Dept.: If you have any interest in serious multimedia development, then subscribe to *New Media Magazine* ($48 a year). If you're looking for a graphics rendering program or a place to get a videodisk manufactured or oddball Photoshop add-ins, then **this is the source.** Call the publisher, HCI, at 609-786-4430 and ask for a free subscription form. Recently the publisher switched to controlled circulation, so you may be able to get the magazine **free.** It's worth paying for.

Laugh of the Week Dept.: As reported in *USA Today,* IBM apparently asked both United and American Airlines for a 6 to 8 percent **discount on airline fares** if IBMers give up their frequent-flyer programs. What kind of cheapskate idea is this? The airlines refused. Meanwhile, *The Wall Street Journal* reported that John Akers received a severance payment of $3 million plus bonuses. The total was $7.5 million for the guy. I wonder if he got to keep his frequent-flyer miles? Apparently, IBM still has problems with priorities. □

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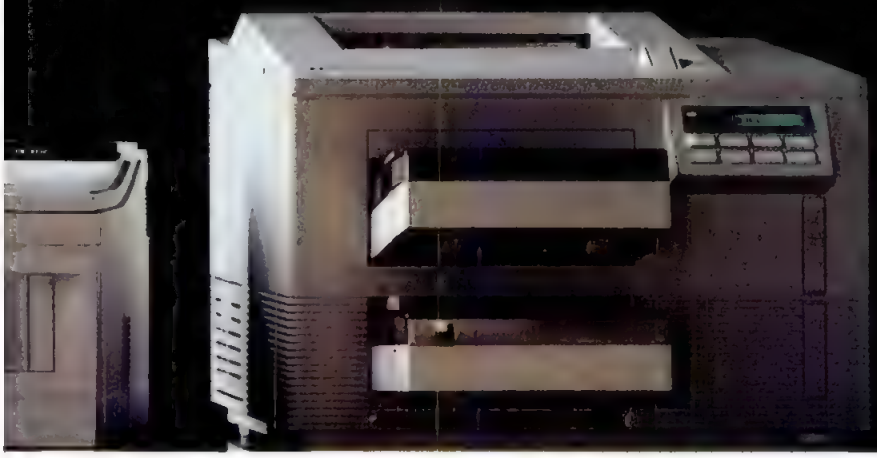

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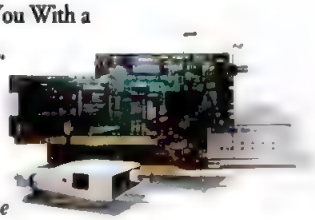

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Jim Seymour

Component Software Is Here *Now*

The hot buzzphrase in PC software these days is *component software.* The idea behind the concept is simple enough to understand, though its implementation and its ramifications for the way we view software are complex.

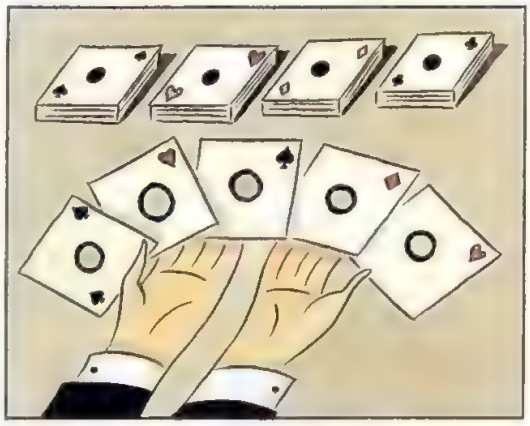
In the era of component software, we'll pick and choose from a long list of software objects to create groups of applications uniquely suited to our needs. For example, I might buy powerful word processor A, semi-powerful but easy-to-use spreadsheet B, SQL database front end C, e-mail manager D—all, conceivably, from different companies—then watch them work seamlessly atop whatever component-supporting operating system I choose.

(Why do I think I hear Ray Charles derisively snorting "Uh-huh!" in the background? Do you think perhaps there's just a tiny chance it won't be quite that smooth?)

Beyond that, in the world of component software I'll also choose what we might call subcomponents to liven up the mix. I'll stir in spell-checker X, grammar checker Y, and chart creator Z as well, to customize my own personal software suite even further.

Today's software suites, in fact, are a good way to think of component software—as long as you can imagine them in reverse. Because with true component software, I don't have to buy all my components in one box, from one vendor (though I still might choose to, for economic reasons); instead, I can mix and match to my heart's delight. Think of component software as the *dis*integration of PC applications—breaking apart the bonds among, say, Lotus's SmartSuite apps or Microsoft's Office apps—which allows me to integrate my personal software choices.

Windows has fostered this kind of thinking, because from its beginnings it has offered some minimal level of integration, or glue, within the operating environment itself. The Windows Clipboard may indeed be a feeble attempt at integration, but it *is* a tool for exchanging data between applications.



To understand the concept of component software, think of today's software suites—only in reverse.

DDE was a somewhat bigger step along that path, even if it was widely misunderstood and generally ineptly implemented; OLE 1.0 was a much bigger step. Now, with OLE 2.0's richer notion of integration and application-to-application connectivity, it's fair to say that integration on the operating-system level is not an unrealistic goal. Chicago (a.k.a. Microsoft Windows 4.0) will enhance the notion of application connectivity and will form a model, many say, for the future of the objects-under-operating-systems approach to PC applications and their integration.

Skeptical? Me too. But I'm becoming less so every day, as I talk with software publishers who are taking concrete steps toward creating the interchangeable objects that make the component approach to software a reality. Among software people, it's an article of faith that we are about to enter the component era.

THE COMING AGE

The coming of component software was a force behind Novell's acquisition of WordPerfect, for instance. Novell sees Microsoft driving the PC business toward a model in which more and more object-linking glue is built into the operating system and users assemble their own portfolios of application objects. With its own applications now, in the form of WordPerfect and Quattro Pro (and soon enough, perhaps, Paradox), Novell believes it is much better equipped to compete in a world of operating system–integrated application-level objects.

Not all of this is betting on what's to come, of course; we already have examples of useful objects. On the developer level, the wide range of commercially available .VBX modules for users of Visual Basic forms a valuable and often very

Illustration by Michael Klein

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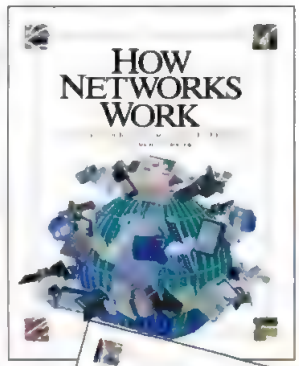

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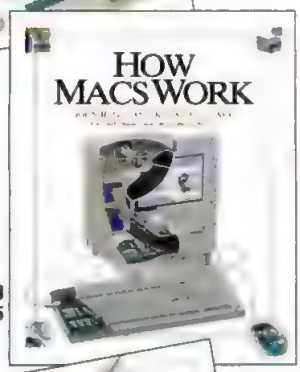

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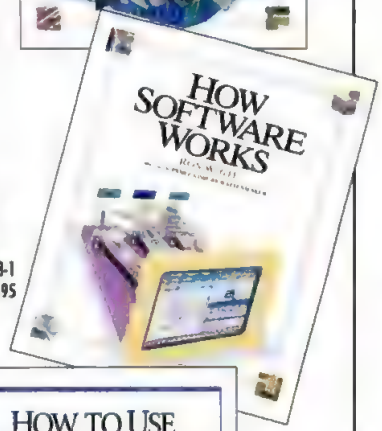

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convenient toolkit for building end user apps more quickly.

More dramatically, Shapeware's new Visio Express shows how well subcomponent software using OLE 2.0 can solve end users' needs directly.

I love Visio, which provides on-screen palettes of shape templates to speed up the drawing process. To draw, you just click on the shape you want—from basic geometric figures such as squares and rectangles to complex shapes such as outlines of office furniture—and drag that figure onto the page. These are "smart" figures: Lines drawn from one to another snap into place, and if one item in a drawing is scaled up or down, all the others change scale to match.

With the advent of Visio 2.0 at the end of 1993, we had the first example of how well an OLE-enabled application from one publisher could work with OLE-enabled applications from another publisher. The new version of Microsoft Office shipped at about the same time, and those of us who used Office's new Word for Windows 6.0 with Visio 2.0 were dazzled at how well such long-promised OLE 2.0 features as in-place editing actually worked.

Shapeware is taking the Visio-as-component idea further in Visio Express, a $79 plug-in for Microsoft Office applications. This plug-in places Express's drawing tools just one click away for Word for Windows and Excel users. Click on the Visio button on the toolbar in either Word for Windows or Excel and you insert an Express object into your document or worksheet. The menu bar changes, too, of course, to show Visio Express's options.

Shapeware devoted extraordinary care to the fit and finish of its menu-swap in Visio Express. You get a new menu bar, a new double-decker toolbar, a splash screen with Express's logo, then a drawing board and the shape template of your choice. When you finish your drawing, you just click outside it and you're back in Word, with Word's native menu and toolbars restored to the screen.

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To be sure, Visio Express is just a hint of what's to come. We won't just see objects that merely extend mainstream applications; at some point we'll see objects that are mainstream-level themselves. But if you want a glimpse of the world of component software to come, take a look at Express today. □

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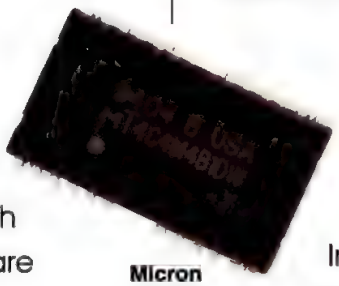

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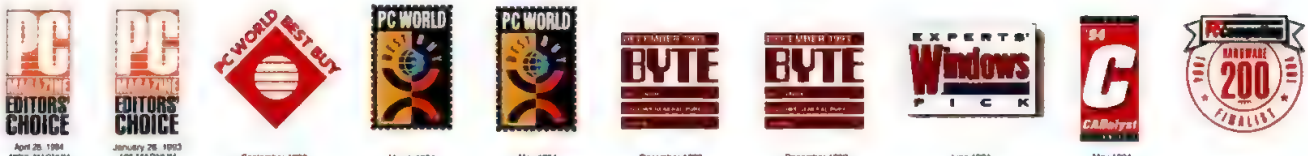

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CIRCLE 119 ON READER SERVICE CARD

Bill Howard

Nice Try—Now Try Harder

It's time to declare the PCMCIA modem an interesting experiment that failed. I'm not against PCMCIA slots on laptop or desktop PCs. They're great. I'm just against putting modems in PCMCIA slots. A modem is such an essential part of a portable PC that it deserves to be built in.

Virtually every PCMCIA modem has a fatal flaw: It requires an expensive, easily misplaced, hard-to-replace connector cable—sometimes called a DAA (data access arrangement), sometimes called a dongle, and often called #*@%&! The dongle connects your RJ-11 phone jack to your modem card.

ADVANTAGES: REAL OR IMAGINARY?

Let's consider what many believe to be the main advantages of PCMCIA modems and disadvantages of built-in modems:

• **Modem standards are changing, and PCMCIA lets you easily switch to new modem technologies.** No matter how fast their modems are, portable users seem to make connections at 9,600 bps (V.32), maybe 14,400 bps (V.32bis), with no data compression, because the modem at the other end hasn't been updated. Anyway, it's likely that laptop vendors will build easily accessible, upgradable internal modems.

• **If it weren't for PCMCIA technology, laptop vendors would have to create a new modem design each time they developed a new system.** Vendors could and should use the same motherboard connector and space each time they design a new system.

• **The external DAA (which contains country-by-country specifics) lets vendors sell—and lets you use—one basic modem around the world.** Made-for-the-U.S.A. modem dongles work perfectly well in most parts of the world. What foreign countries really want is for vendors to pay tribute to their PTT (postal, telephone, and telegraph) certifying boards.

• **You're ignoring a huge world market with U.S.-only devices.** Half the world market *is* the U.S. and Canada. Lots of people never travel outside North America. But if your company does send you overseas, you can borrow a worldwide PCMCIA modem from the company pool.

• **This creates a have/have-not situation; only the biggest vendors will be able to afford to engineer built-in modems.** It won't, but so what if it does? Here's what I believe will happen. The major vendors—Apple, Compaq, IBM, Toshiba, maybe AST, NEC, and Zenith Data Systems—will have enough volume to design built-in modems. Everyone else will use PCMCIA modems, and these users will be stuck with a klunkier solution: card plus dongle. Built-in modems will become more popular because of their convenience factor and, over time, more vendors will go to them.

Near-term, built-in modems will be V.32bis, 14,400-bps data/fax devices. By year's end, we'll begin to see V.34 modems with 28,800-bps signaling. That's the coming standard, rather than V.FC or V.32terbo. Longer term, you'll have a DSP chip that can be any standard for anything (modem, sound board, answering machine) its software desires.

If you have to live with PCMCIA modems, look for those with pop-out RJ-11 connectors from Megahertz, Angia, or U.S. Robotics; consider the Toshiba portables with oversize Type IV (16-mm) slots that take RJ-11 plugs directly; and watch for developments by Intel of a "sideswipe" PCMCIA modem with phone contacts built into the side, allowing future portables with modified PCMCIA slots to have built-in RJ-11 jacks.

Remember, all vendors want your business. Make them work for it. They should design products that are easy for you to use, not just convenient for them to make. Let's leave PCMCIA slots for LANs, sound, SCSI, and removable storage. □

The age of mobile communications demands that modems be built into portables.

Illustration by Michael Klein

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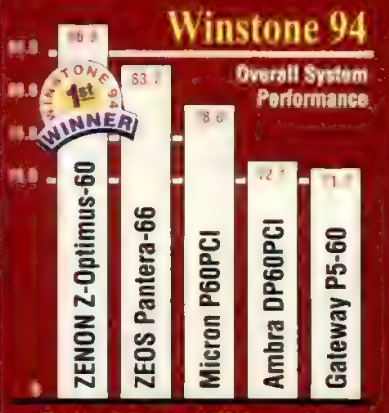

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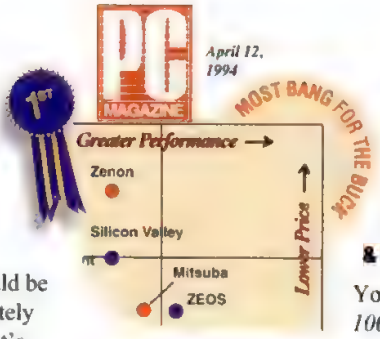

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at five reasons why buyers performance PCs pick Zenon.

more power, including a newer #9 GXE64 Pro 2MB 64bit card with better DOS performance *(you can still have the Matrox MGA-II as reviewed, if you wish, of course!)* Among the PC brands we out-performed—*IBM's Ambra, Dell, Compaq, Digital, ZEOS, Micron, Gateway 2000, and 23 more!* And, we're priced *less* than almost all of these *famous* new powerhouses, even though 6 of them were 66Mhz's!

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If a Pentium PC is too much, and if a 486 PC just won't cut it, take a look at these 26 100-MHz DX4 desktop computers, which are today's PC choice.

100-MHZ DX4 PCs

The Value Performer

Power users who thought the time of the 486 had come and gone had better think again. That's because there's a new 486 in town—the DX4—and systems based on this powerful new chip will give 60-MHz Pentium PCs a run for the money for most Windows users.

In fact, price-conscious users will be pleasantly surprised to see that the DX4 is aimed at those who want high performance but are unwilling to pay Pentium prices. The DX4 CPU, which now defines the top of the 486 line, combines power and price as no processor has before. Bargain hunters should be able to find no-frills DX4/100–based systems for less than $2,500 and more mainstream systems for about $3,000. All in all, the prices of DX4/100 machines should be close to those of comparably configured Pentium/60 systems.

By Mike Feibus

Unlike the Pentium, whose market has taken a year and a half to develop because PC makers needed to design new systems around the 64-bit processor from scratch, the DX4 has hit the ground running. That's because manufacturers needed to make only minor modifications to their 486-family motherboards to ready them

Photograph by Amy Guip

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for the DX4, although some vendors did a better job than others at making these seemingly minor changes.

The net result is that industry analysts expect Intel to ship more than 5 million DX4s this year to PC makers—nearly equaling the number of Pentium shipments, projected to be around 6 million.

But as 486s get better, so do Pentiums. Many of the Pentium processors to be shipped this year will be Intel's new 90-MHz and 100-MHz chips, which are made in the same advanced manufacturing lines as the DX4. For more information on 90-MHz Pentium systems, see the companion review story.

The bottom line is that DX4s are pushing from below and that the higher-speed Pentiums will remain—at least for now—on the top rung of the PC performance ladder. Where does that leave 60-MHz and 66-MHz Pentiums? Intel will continue to produce these 5-volt Pentiums until mid-1995, but few vendors, if any, will devote significant resources to design new systems. This leaves 60- and 66-MHz Pentium systems increasingly squeezed—like middle-seat air travelers between two sumo wrestlers. Only price decreases can save the 5-volt Pentium from oblivion.

REVIEW CRITERIA

To be included in this roundup of PCs based on Intel's latest and greatest 486, we asked for systems that met or exceeded these minimum requirements: 16MB of RAM, a 300MB hard disk, an SVGA graphics subsystem with a 14-inch monitor, a 3.5-inch floppy disk drive, and a CD-ROM drive. We also asked vendors to preinstall DOS 6.0 or later and Windows; 16 units came with Windows 3.1 and 10 came with Windows for Workgroups 3.11, which allows quicker file accesses.

We received 30 systems, several of which could not complete testing. These included PCs from Austin Computer Systems and Insight Computers, which were voluntarily withdrawn. In addition, a Polywell Computers PC had CPU problems, and Tangent Computer's entry had operating-system problems; both were unable to complete our tests. Neither IBM nor Gateway could send us a system in time for testing.

The 26 surviving systems, whose vendors range from Acer to ZEOS, illustrate well the range of PCs people are ordering today, from small-footprint desktop PCs all the way to heavy-duty tower systems that come with nearly 1GB of storage and with 17-inch monitors.

The average DX4-based system in this roundup should bring a smile to the face of anyone searching for serious power at a user-friendly price. For about $3,000, expect to bring home a DX4-based PC with 256K of external cache, 16MB of RAM, a 500MB hard disk, accelerated local-bus graphics with 2MB of VRAM, a double-speed CD-ROM drive, and a 15-inch monitor. There are some high-priced systems in this roundup, but most of those prices can be brought down by eliminating some high-end features such as 4MB hard-disk caches, massive hard disks, and large monitors that most of us

HIGHLIGHTS

100-MHz DX4 PCs

PRICE-CONSCIOUS POWER USERS will find what they are looking for in the DX4 without having to pay Pentium prices. The DX4, which now defines the top of Intel's 486 line, links power and price as no other CPU has before.

A CLOCK-QUADRUPLER IT ISN'T. Though its moniker implies otherwise, the DX4 is actually a clock-tripled CPU. The version found in all 26 of this roundup's systems runs at 100 MHz internally and 33 MHz externally. Intel is producing a 75-MHz version, aimed mainly at the notebook market, and it will make an 83-MHz version sometime in the near future.

$3,500 BUYS A LOT in a DX4 system. For about this price, expect to bring home a DX4-based PC with 256K of external cache, 16MB of RAM, a 500MB hard disk, accelerated local-bus graphics with 2MB of video RAM, a double-speed CD-ROM drive, and a 15-inch color monitor. A DX4-based system should cost about $250 less than a comparably configured 60-MHz Pentium box.

THE LEADER IN CHOICE is Micron Computer, whose DX4 entries include PCI- and VL-Bus–based systems. Both are attractively priced, powerful systems that shine under Windows. But if your workday finds you toggling between DOS and Windows, look to the Tagram Thunderbolt XL, a PC that performed equally well in both environments.

MANY TECHNOLOGICAL enhancements come with the DX4 CPU, including 3.3-volt operation and smaller die size. This chip uses half as much power as its 5-volt predecessors and runs cooler as a result. The DX4 also sports a 16K internal cache—one that's as big as the Pentium's—but there is no split between data and instructions, so caching is less efficient.

COUNT YOUR CACHE before you buy a DX4-based PC: All but 4 of the 26 units in this roundup include 256K of external cache, and the difference showed on our performance tests. If you're going to be doing constant spreadsheet updates or other tight-loop functions, look for a system that employs a write-back—instead of a write-through—design.

VOLTAGE REGULATORS let the 3.3-volt DX4 operate on a 5-volt motherboard. Most vendors attached the regulator somewhere in the processor path; newer system designs integrate the regulator on the motherboard. But watch out: On many of these PCs, the voltage regulators partially blocked the expansion slots.

can live without—for now.

A notable member of the bunch is the Micron 486DX4 (PCI) system, which is attractively priced at $3,199. It was the star performer on our Windows-based benchmark tests. Incredibly, this 486 system's impressive Winstone score of 88.2 even beat all 31 of the 60- and 66-MHz Pentium PCs reviewed in our issue of April 12, 1994. The top performer in that group, the Dell OmniPlex 566, garnered a Winstone score of 88.1. In terms of processor horsepower, however, the Dell OmniPlex 566 put the Micron 486DX4 (PCI) system in its place. Micron's system may have earned the highest processor score in the DX4 roundup, but its score of 64.3 paled next to the Dell OmniPlex's 80.7.

For $200 less than the PCI-based system, Micron also offers a VL-Bus–based system that is based on a similar motherboard, is identically configured, and performed just as well on our benchmark tests. Both are excellent systems, so which one you decide to buy would depend on how much you're willing to spend and on which local-bus design you prefer.

For those who consider price the primary determinant of which PC to buy, the EPS Technologies' EPS D4G 100 offers the sweetest price: $2,595. Two notable systems straddled the $2,750 mark and offer high-end performance: The $2,895 ZEOS Pantera DX4-100 combined stellar performance on most of our benchmark tests with Energy Star compliance; The $2,699 VL-Bus–based Tagram Thunderbolt XL scored equally as high under both DOS and Windows, making it the system of choice for those users who work in both worlds.

VL-BUS VS. PCI

Of the systems in this lineup, 19 use VL-Bus designs, 3 use PCI, and 3 use proprietary local-bus arrangements—the Dell OptiPlex 4100L, Compaq ProLinea 4/100 Model 340/w, and Compaq Deskpro XE 4100 Model 525/w (both Compaq entries use QVision architecture).

In terms of flexibility, the GCH EasyData 4100T is remarkable because it uses ISA, PCI, and VL-Bus. Unfortunately, the GCH EasyData is a jack of all trades, master of none, implementing both PCI and VL-Bus passably but neither particularly well. Peripheral performance suffers, and much of this flexibility is hard to use once the cover is opened: Full-length cards won't fit into many of the expansion slots, because access is blocked by componentry.

But the GCH system isn't alone in this regard. In fact, many of the units suffered from partially blocked expansion slots—more than a few because of the new voltage-regulator circuitry required by the DX4. The most effective designs leave all expansion slots free of obstruction, and such designs are found in systems from Acer, AST Research, Compaq, and HP.

To use an existing 486 motherboard in a DX4 system, PC makers needed to find a way to power the new processor, which uses 3.3 volts and would burn out in a puff of expensive ozone if wired to a 5-volt motherboard. In many cases, manufactur-

PC MAGAZINE EDITORS' CHOICE

• Tagram Thunderbolt XL
• ZEOS Pantera 486DX4-100

In the realm of mainstream personal computers, buyers usually have to settle for performance that is a notch below the best available because of price. In return, however, they reap the dividends of a much lower price and gain the confidence and comfort that comes from using established technology.

While this group of 26 DX4/100–based PCs contains many systems that excelled in one area or another, only two systems stood out from the pack by combining in equal amounts the best in performance, features, and price. If your work generally takes you to both DOS and Windows worlds, then the Editors' Choice winners, the $2,699 Tagram Thunderbolt XL and the $2,895 ZEOS Pantera DX4-100—should satisfy your computing needs.

BEST OF BREED

One of the least expensive of the DX4-based systems in this roundup, the Tagram Thunderbolt doesn't skimp on features and performance to achieve its admirable $2,699 price. Tagram, a relative newcomer to the PC business, has teamed up with motherboard-maker BCM Advanced Research to produce a flexible VL-Bus–based personal computer that delivers in terms of value.

In terms of performance, the Tagram Thunderbolt lived up to its name and then some. It took top-ten finishes on all benchmark tests. What was most notable about this system's performance was its level of consistency. The Tagram Thunderbolt performed equally well on DOS and Windows applications, taking the top DOSMark score and the sixth-best Winstone 94 score.

The ZEOS Pantera DX4-100 demonstrated exceptional processing ability (it was second best on our processor tests) and disk performance (it was second best on our Disk WinMark tests) with a price that is easy to take. This is an even-handed system that should give the user no unpleasant surprises. To that, add the consistently superior service and support that gives ZEOS buyers an extra level of confidence.

If freedom of choice is important, the pair of DX4-based PCs from Micron lets you specify which local-bus system you want, with the full assurance that you're getting the best Windows performance available.

If you're most interested in the high-performance PCI bus, then the $3,199 Micron 486DX4 (PCI) system is worth a look. If your budget is a little tight these days, consider the PCI-based Micron's cousin, the $2,999 Micron 486DX4 (VL-Bus).

While the two systems have slightly different motherboards, they are extremely close in terms of features and performance. By offering two local-bus alternatives, Micron deserves honorable mention in this stellar group of DX4/100–based PCs.

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intel inside

When we introduced the Compaq ProLinea, it was more than just a new computer. It was a whole new idea. The first computer to deliver the right features and high quality at a price that was affordable for everyone.

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CIRCLE 308 ON READER SERVICE CARD

ers chose to bolt on a voltage regulator somewhere on the processor path to the motherboard; this device decreases the voltage running to the chip to 3.3 volts. The Dell OptiPlex 4100L provides an example, though not the only one, of a less-than-elegant-looking voltage converter. Hiding underneath a relatively flat heat sink is a baseball card–size module that contains the voltage-regulation circuitry. The module is sandwiched between the DX4 processor and the motheroard's ZIF socket.

By contrast, newer system designs, such as those by Micron, include the voltage regulator on the motherboard, and many also feature autoselectable voltage, so computer users don't need to do anything to operate either a 5-volt or 3.3-volt processor. There's a third class of PCs with regard to voltage regulation. In these, motherboard manufacturers bolted the voltage regulator onto the motherboard directly on the power-path circuit.

It's often hard to tell the new designs apart from the adapted ones, because both have voltage regulators surrounded by large U-shaped heat sinks, which carry away the heat that is produced when the voltage is reduced. The heat sink doesn't really do much—at least not today. The DX4 isn't enough of a power-hungry processor to cook the voltage regulator. It's there primarily in case you decide to upgrade the system to a Pentium-class processor. But more on that later.

REGENT REVIEWS

Tomorrow's PC
May 31, 1994 ..... *page 112*
RISC technology continues to chip away at Intel dominance. Some say it's the way of the future. Is it right for you? We compare RISC to CISC, test 14 workstations and 6 servers, and let you know.

Power to the PC
April 26, 1994 ..... *page 114*
PC Magazine covers the oh-so-PC topic of energy-efficient PCs. We test 38 machines—fast, eco-acceptable, and suprisingly inexpensive.

Unleashing the Power of Pentium
April 12, 1994 ..... *page 114*
We look at 31 Pentium systems with local-bus video subsystems to see which is the best of the second round of Pentium systems.

If you plan to hold onto your system for a long time, you may want to think twice before you buy a system with a retrofit module. Depending on how the retrofit is implemented, it might come back to haunt you if you ever decide to upgrade the processor. Specifically, it might force you to buy a retrofitted upgrade processor directly from the PC manufacturer—and that most likely will be more expensive than off-the-shelf upgrades from Intel or others.

A LOOK INSIDE THE DX4

Don't let the name fool you. There's no "486" in front of the DX, but there is no doubt that this chip is a full-fledged member of Intel's 486 family. And if you're familiar with clock-doubled DX2 processors, you might be inclined to think that the DX4 is clock-quadrupled, but it isn't.

Initially available in a 100-MHz implementation, the DX4 is actually a clock-tripled processor, running at 100 MHz internally and 33 MHz externally. Intel decided to drop the 486 nomenclature now that it lost a bid to enforce copyrights on the 486 name. It's got a better chance at protecting the DX4 name—and sooner or later it will have to, with clock-tripled 486s rumored to be in the works from competi-

Suitability to Task: 100-MHz DX4 PCs

The only system to achieve a rating of *excellent* in all three Suitability to Task categories, International Instrumentation's Blue Max Business Partner DX4100 stands out from the pack.

The **DOS applications** score reflects a system's ability to run DOS software efficiently. *Excellent* systems are those that earned top DOSmark scores on our benchmark tests and can run TSRs and memory-intensive DOS applications.

Windows applications is a more demanding category; the rating indicates how well a system will operate Windows software. It takes into account system hardware and benchmark test results, including Graphics WinMark and Disk WinMark benchmark test scores in addition to the score each system earned on our Winstone 94 applications test.

We also give weight to hardware factors such as the maximum RAM a system allows (either on the motherboard or via a proprietary add-in card). Finally, we take into account a system's hard disk options and the diagonal size of its monitor.

Those systems with *excellent* ratings in this category posted stellar processor scores on our benchmark tests. They contained top-flight video controllers and fast hard disks, as evidenced by their excellent Graphics WinMark and Disk WinMark scores. Fewer systems garnered *excellent* ratings in this category than in our DOS applications category.

Expandability refers to a system's potential for growth. Considerations include ease of processor and external cache upgrades, system BIOS, hard disk options, maximum RAM installable on the motherboard and via expansion cards, available drive bays and bus slots, the presence of a flash-upgradable BIOS system, and the presence of a 16550 UART high-speed serial-port chip. The best systems have drive bays and slots to spare and have been designed so that their processor and external cache subsystems are easily upgradable.

With so many factors involved, it is not at all surprising that those systems with *excellent* ratings in this category are not just towering cases but robust models designed with the high-performance-PC user in mind.

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	GOOD
Expandability	EXCELLENT
VENDOR SERVICE & RELIABILITY	
Reliability	BELOW AVERAGE
Repair service	AVERAGE
Technical support	ABOVE AVERAGE

SERVICE AND RELIABILITY

In our 1994 Service and Reliability Survey, we sent questionnaires to 17,000 subscribers; about half replied. Vendors for which we received at least 50 responses are rated *above average, average,* or *below average* in three areas.

Reliability scores indicate to what degree PC owners felt their systems met their overall expectations for consistent operation.

Repair service scores are culled from users who contacted the vendors to have their PCs repaired.

Technical support scores measure how well vendors' telephone support met respondents' expectations.

Price/Performance Index: *100-MHz DX4 PCs*

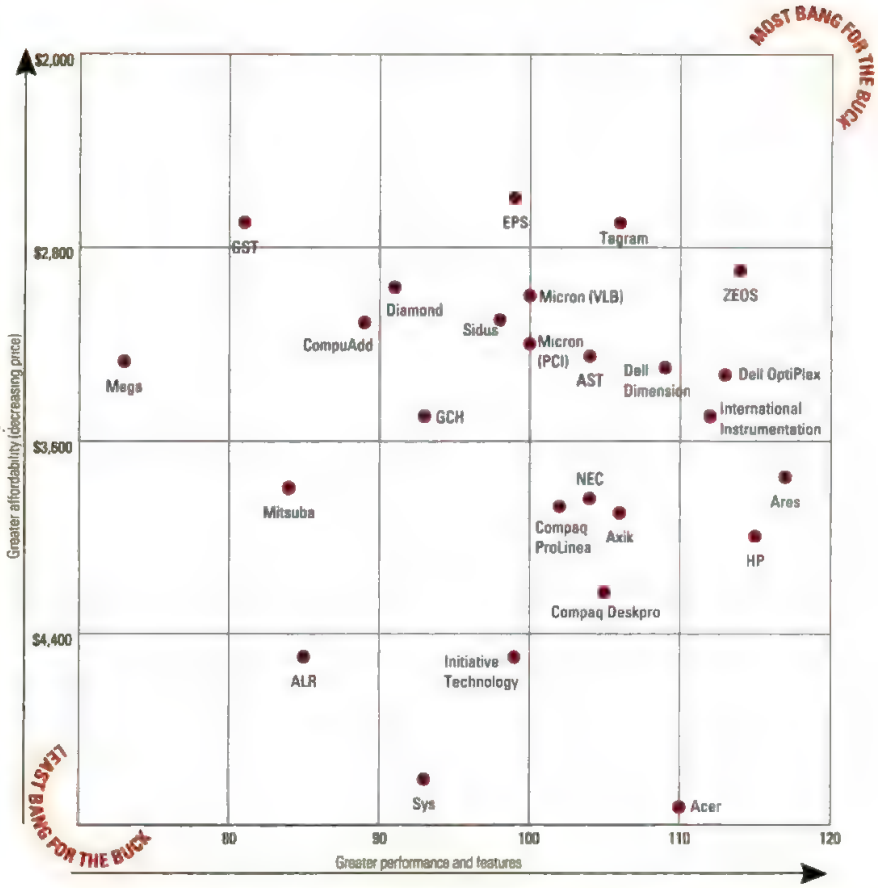
For the best value in a DX4/100–based system, look to Tagram System Corp.—a newcomer to the PC marketplace—and ZEOS International. Both vendors' machines receive Editors' Choice awards and came in at under $3,000.

For budget-minded PC shoppers, the Tagram Thunderbolt XL offers the most bang for the buck. This machine's performance/features rating places it in the top third of the group, and the unit costs only $100 more than the system with the lowest price. While the ZEOS Pantera DX4-100 earns a higher performance/features score than the Tagram Thunderbolt, its price doesn't quite match that of the Tagram machine.

The lowest-priced machine in this roundup, the $2,595 EPS D4G 100, follows closely at the heels of the Tagram and ZEOS systems on our price/performance index, but its performance/features score holds it back.

The Ares DX4/100 turned in the best performance of the group; the system is priced, however, at $3,749—well above average for the systems in this lineup.

Two machines that didn't quite measure up to the competition were the Mega Impact 486DX4/100D+ and the Mitsuba VESA-DX4. Both suffered from poor performance showings across the board on our benchmark tests.



THE DATA POINTS

Each unit's performance/features score indicates both how well the system performed on our benchmark tests and the variety of features that the system includes. Our benchmark test scores account for 65 percent of a system's performance/features score. Almost 15 percent is based on the vendor's policy concerning warranty, customer service, and support features.

The rest of the performance/features score is based on features such as upgrade capability, monitor size, and hard disk capacity. The price for each unit is based on its tested configuration, as reported in the fact files. For more information, look in the Hardware Library of the Editorial Forum on ZiffNet under 12BANG.XLS.

tors such as Advanced Micro Devices and Cyrix. In addition to 100-MHz DX4s, expect Intel to produce a 75-MHz CPU—which will end up mostly in notebooks—and a desktop 83-MHz processor. For more information on the DX4 CPU, see the Tutor section in this issue.

There are other areas aside from clock-tripling technology in which the DX4 advances the state of the 486. For example, the DX4 operates at 3.3 volts instead of 5 volts. That means the chip uses about half as much power and runs cooler as a result. This allows many DX4-based systems to operate safely and reliably without internal fans. In contrast, virtually all DX2- and Pentium-based PCs include a CPU fan to whisk warm air away from the processor.

The other significant difference in the DX4 is that it sports a 16K internal cache—double that of previous 486s. This brings internal cache up to the level of that used in Pentium processors. But because DX4s do not divide the cache into data and instruction sections, caching is not as efficient. In theory, a bigger built-in cache means that the processor won't need to spend as much time asking for data from the slower system memory and hard disk, because there's a higher probability that the information it needs is ready and waiting.

The 16K internal cache inside the DX4 helps, but all 26 DX4-based PCs reviewed here included an external cache. All but four of the systems featured a 256K cache, which tells you just how important an external cache is. The others were configured with only 128K of cache, and only one of them—the Sidus SCI933Dg/VL—turned in a processor score that placed it

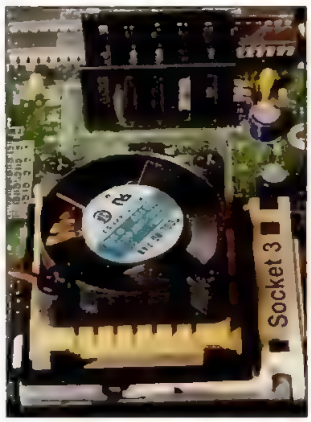
in the top half of the pack. Even Compaq redesigned the motherboard in its aging ProLinea line to add an external cache. The older ProLinea-series motherboard was adequate for systems built around 25- and 33-MHz processors but was having trouble keeping up with faster processors. Even with a 128K external cache, the ProLinea still lagged behind the pack in terms of processor performance.

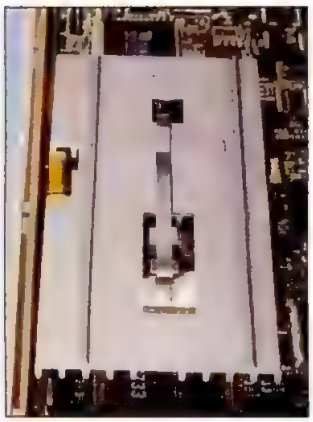
We recommend pairing a DX4/100 with at least a 256K cache. Some of the better-performing external caches in our roundup employ a write-back design, which generally performs cache writes more quickly than a write-through design. Of the 26 systems in this roundup, 22 employ a write-back design.

ONE CACHE FOR ANOTHER

While it certainly makes sense to lean toward a larger external processor cache—at least up to a point—these systems' test scores hint that there is a different story to tell with hard-disk caches. Several systems in our roundup come with hard disk controllers jam-packed with cache. In most cases, these sizable hard disk controller caches add hundreds of dollars to the cost of the systems; yet these machines often don't show proportional performance improvement. You might be better off investing in a good software cache.

A look at the Micron 486DX4 (VLB) and the ZEOS Pantera DX4-100 is instructive. Both have integrated hard disk controllers with no cache; yet Micron's entry took first place on our Disk WinMark tests and fourth place on our DOS disk tests. The ZEOS Pantera DX4-100 took second place on our Disk WinMark tests and eighth place on our DOS disk tests. On the other hand, the Axik Ace Cache 486DX4-100PCI/MPC—with a 4MB local-bus disk controller cache—and the GCH EasyData 4100T—with an 8MB local-bus disk controller cache—placed in the top half of the roundup on our disk tests, but neither beat the Micron 486DX4 (VLB). And the closest that either system came to the ZEOS unit was a near-tie performance turned in by the GCH EasyData. So buyers should think twice before plunking down money for a system with a big chunk of hard disk controller cache. The systems in this roundup that did the best on our Disk WinMark tests were running Microsoft Windows for Workgroups 3.11, which features advanced software caching technology that is far superior to what is packaged in Windows 3.1.





The voltage converter on Micron's VL-Bus machine (left) is a clean, compact design. But the Dell OptiPlex 4100L's converter (right) uses an overhanging top heat sink that is twice the length of the other modules.

Graphics is another area where penny pinchers might want to look to save money. Many of the machines in this roundup included graphics subsystems built around the reigning champs: the Matrox MGA card, using the MGA chip, or the Diamond Viper card using last year's high-flier, the Weitek Power 9000 chip. Both of these boards use high-performance—and high-priced—VRAM for graphics memory. Several systems—including the EPS D4G 100, International Instrumentation's Blue Max BP DX4100, and the Tagram Thunderbolt—made it into the top half of the bunch on both our DOS- and Windows-based graphics tests with graphics systems built around less expensive DRAM-based controllers such as Tseng Labs' ET4000/W32 and Cirrus Logic's CL-GD5434.

EXPRESS-LANE GRAPHICS

Speeding up graphics was the impetus behind taking the display controller off the ISA bus and putting it on a local bus. Industry pundits generally agree that the VL-Bus, which has been virtually synonymous with 486 local-bus technology, will continue to dominate 486 PC shipments, while Intel's late-blooming PCI standard would muscle its way inside systems built around the Pentium and other high-performance processors. But Intel isn't satisfied to have PCI just own the future. It wants PCI in the hands of as many computer users as possible—as soon as possible. That's why Intel is selling a PCI chip set for 486 systems—and several of the PCs in the roundup have taken Intel up on the proposition. Three of the systems offer PCI expansion—remarkable considering that these are evolutionary 486 designs.

Comparing the performance of PCI-based systems with that of VL-Bus units, it was no slam dunk for PCI. But generally speaking, the PCI systems did fare slightly better on many tests than the systems with VL-Bus local-bus expansion. And two of the top performers—the Micron 486DX4 (PCI) and ZEOS Pantera DX4-100—were both PCI-based systems.

But you don't need PCI to bring the DX4 into your world in a newly designed computer. Several of the VL-Bus systems—including the CompuAdd C4100D, Dell Dimension XPS 4100V, and Micron 486DX4 (VLB)—are built around new designs. And neither does newer necessarily mean better. Dell, for example, knew when to stick with a good thing. The Dell OptiPlex 4100L is a solid performer among the DX4s in our roundup.

WATCH THIS SPACE

Just when you think you had all your options sorted out, Intel throws another

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curveball into the processor mix. By fall, expect the arrival of a 100-MHz processor that is a hybrid of 486 and Pentium design. Called Pentium OverDrive, this CPU will fit in those large empty sockets many systems have been sporting for the last year. The difference between the old and new systems is that today's systems will actually be tested by Intel for both electronic compatibility with the new chip and the ability to dissipate the chip's waste heat. Intel has set up a program it calls Verification that will guarantee compatibility, because each system will actually be tested. So far, some 450 PC models have passed muster. The Pentium OverDrive chip should provide upgraders with a performance boost of anywhere from 40 to 70 percent.

In the end, though, you'll be glad that the DX4 upset the applecart—because you'll probably walk away spending less money for more power than you ever thought possible. For the time being, if you're the kind who spends whatever it takes to get the fastest machine around, check out systems based on the new 90-MHz and 100-MHz Pentiums. But if what you crave is Windows performance on a budget, then there's probably a DX4 in your future.

Acer America Corp.

• AcerAltos 800

The $5,112 AcerAltos 800 is expensive by the standards of this test group, but it provides the high data throughput of an EISA bus, consistent performance, and impressive upgrade possibilities.

The unit came in a mini-tower case whose cover is hinged and opens to the left. Motherboard and slots are on the open side, drive bays and power supply on the other, making all components easily accessible. Three of the eight drive bays are in use, as are two of the four SIMM sockets. There are six EISA slots, all free, and two additional slots with VL-Bus extensions. Only one of these is occupied by the video card carrying the ATI Mach32 chip set and 2MB of VRAM. Other I/O and disk controllers are integrated on the motherboard. The only problem here is that the proprietary processor slot is right next to one of the EISA slots, limiting the length of card that can be used there.

The AcerAltos 800 was not a star performer, but it managed to give even-handed results. It did best in the DOS environment, especially on our DOS video test. Windows scores ranged from about average to below average for the group. The Fujitsu drive and its integrated controller did not help the system on either our DOS or Windows disk tests, however, where the Acer had two of the lowest scores in this roundup.

Acer has a one-year standard warranty with on-site service included and 24-hour, 7-day toll-free technical support. —*Anush Yegyazarian*

▶ FACT FILE

AcerAltos 800

List price: $5,112. **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache **Data storage:** Fujitsu 520MB SCSI-2 hard disk with 512K cache, integrated disk controller, Sony 541 CD-ROM drive **Display:** Acer AcerGraph L45 VL-Bus video controller card with 2MB VRAM, Acer AcerView 76i 17-inch monitor with a 87-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.2, Windows 3.1. **In short:** The EISA-based AcerAltos 800 was not a star performer and comes in at a higher-than-average price.

Acer America Corp.; 800-368-2237, 408-432-6200; fax, 408-922-2953.

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SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	EXCELLENT
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	AVERAGE
Technical support	BELOW AVERAGE

Advanced Logic Research Inc.

• ALR Evolution IV 4/100

The ALR Evolution IV 4/100 offers midrange, though inconsistent, performance but has only limited expansion room. At $4,494, it's no bargain.

Our test unit came in a small-footprint desktop case with three of its four drive bays already in use. Its three SIMM banks (which were full on our unit) are located beneath a drive cage, so upgrades may be difficult. This unit's standard 256K processor cache is located on a proprietary card; no other configurations are available. A CD-ROM drive controller fills one of the four ISA slots; the others are free, but one cannot accommodate a full-length expansion card because of its proximity to the proprietary cache slot. The two additional ISA slots with VL-Bus extensions are both filled: one with the Tekram hard disk controller, the other with the Matrox video controller. Regular I/O ports are integrated, while a SCSI port is provided through the CD-ROM controller.

This unit showed somewhat uneven performance. Its Matrox video card performed as expected, achieving great results under Windows and equally poor results under DOS. A top-five Graphics WinMark score and an above-average processor score were enough to make up for mediocre hard disk performance (under DOS and Windows) and deliver an average Winstone score. Because of a lower-than-average DOS disk score, this system's DOSmark score was below average.—*AY*

▶ FACT FILE

ALR Evolution IV 4/100

List price: $4,494 **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache **Data storage:** Western Digital 425MB IDE hard disk with 128K cache, Tekram VL-Bus disk controller card with 2MB cache, Plextor DM-3028 CD-ROM drive. **Display:** Matrox MGA-VLB/2 VL-Bus video controller card with 2MB VRAM, ALR ClearVIEW 15 15-inch monitor with a 70-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.2, Windows 3.1. **In short:** This unit yielded somewhat uneven performance and has limited expansion room.

Advanced Logic Research Inc., 800-444-4257, 714-581-6770; fax, 714-581-9240.

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SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	GOOD
Expandability	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	BELOW AVERAGE
Repair service	BELOW AVERAGE
Technical support	BELOW AVERAGE

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Microsoft

[illegible]

Benchmark Tests: 100-MHz DX4 PCs

With a wide variety of implementations, this group of 26 of the first Intel DX4/100–based PCs showed a wide range in performance. The best systems went to great lengths to optimize memory, disk, and graphics subsystems and to produce good all-around performance.

What the Numbers Mean

WINSTONE 94

With the best processor and Graphics WinMark scores and a second-place Winstone showing, the Micron 486DX4 (PCI) is an excellent performance choice in this roundup of Intel DX4/100 systems. By the same token, the top scorer on our Winstone test was the Micron 486DX4 (VLB), which has a different motherboard than the PCI entry but similar peripherals. This system turned in the second-place Graphics WinMark score (each Micron system comes with a Matrox video card with 2MB of VRAM) and a top-ten processor score. Both Micron systems produced excellent Disk WinMark scores as well, which helped to ensure their solid Winstone standings.

ZEOS's PCI-based system, the ZEOS Pantera DX4-100, showed strong Disk WinMark performance, too, with a second-place score of 2,300. It also turned in the second-best processor score. But with a Winstone score of 74.5, the ZEOS Pantera DX4-100 just missed making the top-ten list in this category. The system's Diamond Viper video card is what kept it off the list.

This video card, based on the Weitek Power 9000 chip, is still one of the hottest Windows graphics boards around; it helped the ZEOS Pantera DX4-100 earn a respectable Graphics WinMark score of 19.3 million pixels per second. But the pairing of Viper video cards with the new DX4 processors produced inconsistent Graphics WinMark scores throughout the lineup and contributed to a wide range of Winstone scores, as evidenced, for example, by the ITI 499VL, GCH EasyData 4100T, and Mega Impact 486DX4/100D+, all three of which use Diamond Viper video cards. The GCH EasyData ranked 19th on our processor tests, with a score of 53.8. On our Graphics WinMark tests, this system ranked 18th, with a score of 16.9. It performed roughly on a par with the ZEOS Pantera DX4-100 on our Winstone test. On the other hand, the Mega Impact turned in a Graphics WinMark score of 17.9 and got no Winstone lift at all to counter its 22nd-place processor score. This unit posted the second-lowest score on our Winstone test—in part because of its last-place Disk WinMark score. The ITI 499VL ranked 12th on our processor tests and fourth on our Winstone test. This showing was due primarily to the unit's solid performances on our Graphics WinMark and Disk WinMark tests.

The Winstone scores of systems with Matrox video cards were more consistent with their Graphics WinMark, Disk WinMark, and processor scores.

PROCESSOR

The name implies clock quadrupling, but the DX4/100 CPU is actually the 100-MHz version of a clock-tripled 486DX/33 CPU. If that's not confusing enough, look how the chip performs in these 26 systems. Processor test scores ranged from a low of 44.1 (for the Compaq ProLinea 4/100 Model 340/w) to a high of 64.3 (for the Micron 486DX4 (PCI)). This means that the fastest system in this lineup performed about 45 percent faster than the slowest—which is typical considering the size of this group and the wide array of motherboards and chip set designs represented.

In the "486 Buyers' Guide" (December 7, 1993), for instance, we looked at 191 systems. The fastest 486DX/33 performed 32 percent faster than the slowest. The speediest 486DX2/66 outperformed the pokiest by 73 percent. Differences in how motherboards are optimized accounts for much of the performance spreads we saw. The fact that 486DX/33s, 486DX2/66s, and DX4/100s can all share the same motherboard explains the popularity of the DX4/100 chip among vendors.

While same-CPU performance spreads are normal, they can also be more or less explained by inspecting motherboard components. But in this roundup, external-cache size, chip set design, motherboard, and BIOS didn't cluster as they typically do when we separate the winners from the losers. The range of memory-to-CPU designs is the pivotal culprit (assuming all the systems are actually running at 100 MHz).

For example, several systems in this roundup use a Micronics JX-30GC motherboard, with Micronics' 471 chip set (manufactured by Silicon Integrated Systems Corp.), 256K of direct-mapped write-back cache, and a Phoenix BIOS. So the main difference among those machines is memory design, and their processor scores ranged from 47.9 (the GST 486V4) to 62.8 (the Sidus SCI933Dg/VL). A similar Micronics motherboard with Intel's PCI chip set helped the Micron 486DX4 (PCI) system garner the highest score of the group: 64.3. The ZEOS Pantera DX4-100—also using Intel's PCI chip set but on an Intel motherboard—turned in a 63.9, the second-highest score on our processor tests. Compaq's entries—the Compaq ProLinea and Compaq Deskpro XE 4100 Model 525/w—fell at the other end of the performance spectrum, with processor scores of 44.1 and 46.6, respectively. Neither model's memory subsystem was capable of keeping up with the DX4/100 processor. To make matters worse, these systems are packed with 25-nanosecond SRAM chips, the slowest in this lineup, for their caches.

A number of systems joined Compaq at the bottom of the performance chart, however. Systems by Mitsuba Corp., Diamond Technologies, Mega Computer Corp., and Golden Star Technology—all with processor scores under 50—also showed signs of poor memory-to-CPU designs. On closer inspection of the individual tests that make up our processor scores, each of these systems demonstrated poor timing at the

very heart of the CPU subsystem. The processing of our small instruction mix, which fits entirely inside the DX4's 16K of on-board cache, took 5 to 25 percent longer in these systems than in those with the highest processor scores.

There are currently more 33-MHz motherboards on the market than motherboards of any other speed. While most use 5-volt designs, the DX4 is a 3.3-volt chip. With a relatively simple and inexpensive voltage regulator, DX4 CPUs can be used on any 5-volt 33-MHz motherboard that supports a 486 chip pinout. Every system in this lineup relied on a voltage converter of some sort, whether elegant or elaborate. In theory, such devices should not impede processor performance. But since they're still much too new and have not yet been standardized, it is hard to say for sure that they will not affect performance.

GRAPHICS WINMARK

As indicated in the Winstone analysis above, Diamond Viper cards, equipped with the capable Weitek Power 9000 chip, contributed to a few Graphics WinMark scores that defied the following rule of thumb: Systems with the best processor scores, using the same graphics chip and driver, usually generate the best Graphics WinMark scores. This rule held with each of the five systems equipped with Matrox MGA video cards; the systems that turned in the top five Graphics WinMark scores use Matrox cards. But those systems using Diamond Viper cards turned in Graphics WinMark scores with little correlation to processor performance. It's possible that there are timing issues yet to be resolved with the DX4s and the Viper cards. But this is also an issue that is probably linked to video drivers. Though all the systems with Viper cards use the same driver, the two systems whose Graphics WinMark scores showed the least correlation to their processor scores—the ZEOS Pantera DX4-100 and the GCH EasyData—use a more current release. None of the Viper-equipped systems employ the dithering capability of Weitek's chip, however, which has been known to have a positive effect on Graphics WinMark scores.

If your day-to-day graphics needs include both DOS and Windows, look for a system with an ET4000/W32 chip.

The four systems in the lineup based on the PCI bus architecture—the Axik Ace Cache 486DX4-100PCI/MPC, GCH EasyData, Micron 486DX4 (PCI), and ZEOS Pantera DX4-100—did not necessarily outperform their VL-Bus counterparts. The only one that did was Micron's system, one of the five units with Matrox's MGA card. But this system also turned in the best processor score, which accounted for its edge over the VL-Bus competition with Matrox cards and made possible its outstanding Graphics WinMark score of 28.2.

Video memory also played a role in this lineup. Most systems came equipped with 2MB of DRAM or VRAM. With the exception of the Compaq Deskpro and the NEC Image 4100ES, those systems with just 1MB of video memory ranked at the bottom on our Graphics WinMark tests.

DOS VIDEO

Despite inconsistencies in Graphics WinMark scores among these DX4/100 PCs, scores on the DOS video tests sorted out as expected. The five systems with Matrox cards had low rankings in this area, with an average score of 577. The five PCs with Diamond Viper cards ranked just above, with an average score of 1,391.

Clustered at the top of the list were the seven units with Tseng Labs' ET4000/W32 video chips. Their average score was an impressive 6,283. Most remarkable of all was the NEC Image's score of 7,056, one of the highest DOS video scores recorded since PC Bench 8.0 was introduced last fall. Squeezed in among the top-scoring ET4000/W32 crowd was the HP Vectra VL2 4/100 PC, with a Cirrus Logic GD5428 video chip, which helped the system score 5,277. The other three systems with Cirrus Logic chips and the four units with ATI Mach32 graphics chip sets turned in scores that placed them in the middle of the pack on our DOS video tests.

As we've seen in previous roundups, if your day-to-day graphics needs include both DOS and Windows work, look for a system with an ET4000/W32 chip, because it offers outstanding DOS video performance and uncompromised performance under Windows.

DISK WINMARK

The ten systems with Microsoft Windows for Workgroups 3.11 (WfWG) installed averaged 1,983 on our Disk WinMark tests. The remaining systems, configured with Microsoft Windows 3.1, turned in an average score of 1,297. Part of the reason for the performance disparity is that WfWG contains a more advanced software disk-caching routine than Windows 3.1 and can perform 32-bit file accesses. Even though we normalize disk cache settings and swap files between systems running WfWG and those running Windows 3.1 (for benchmark test purposes), in most cases, WfWG will result in a better disk score.

A good disk score alone, however, does not necessarily translate into top applications performance. A system still must have strong core processor performance and a good graphics subsystem to do well on our Winstone test.

DOS DISK

Most of the systems in this DX4/100 lineup produced respectable DOS disk scores, with an average of 1,470. The Mega Impact's score of 1,053, the lowest in the roundup, deviated from the average by only 28 percent. The highest score—1,906, for the Sys Business Series 486DX4/100-Full Tower—was just 30 percent better than the average score. We credit the Sys computer's strong showing, in part, to the 8MB DC-680C caching controller in one of its VL-Bus slots, paired with the unit's 976MB Micropolis 2210A IDE hard disk.

Benchmark Tests: 100-MHz DX4 PCs

DOSMARK

With a good DOS video score and average DOS disk performance, nearly any system will achieve a respectable DOSmark score. But since processor performance is weighted heavily in the DOSmark formula, even those systems with outstanding DOS video performance can't overcome a poor processor score. As proof, five of the systems with Tseng Labs' ET4000/W32 video cards—currently the best for DOS video performance—turned in some of the highest DOSmark scores, ranging from 934 (for the Ares DX4/100) to 1,013 (for the Tagram Thunderbolt XL). All five demonstrated average-to-excellent DOS disk performance and turned in strong processor scores. But the two remaining systems with ET4000/ W32 chips, the Mitsuba VESA-DX4 and the Compaq ProLinea, produced DOSmark scores in the low 700s—which were directly attributable to the systems' extremely low processor scores of 46.0 and 44.1, respectively.

—Analysis written by Tami D. Peterson

How We Tested

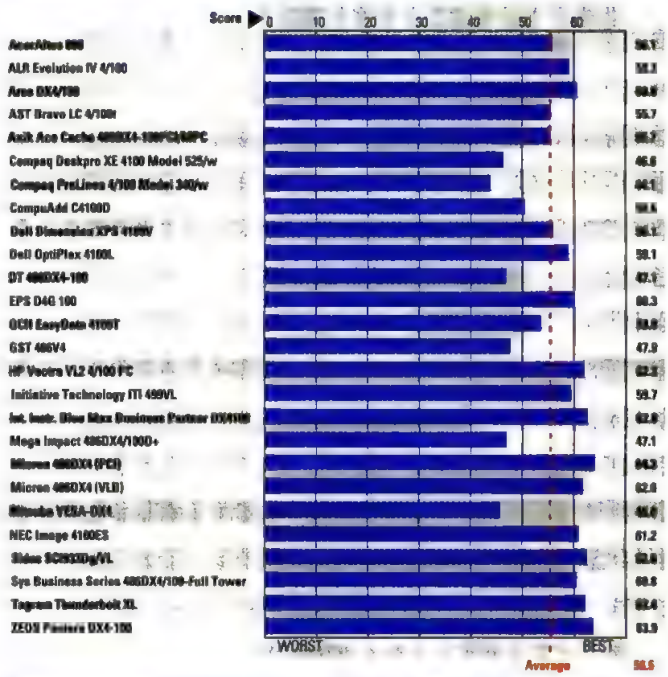
In preparing this issue, we used PC Bench 8.0 to predict processor, video subsystem, and disk performance using DOS applications. The DOSmark is a summary of those three results and estimates system performance under DOS. We also used WinBench 4.0 to obtain Graphics and Disk WinMark scores, and we used the application-based Winstone 94, Version 1.0, to determine overall system performance under Microsoft Windows 3.1.

Winstone 94, Version 1.0, measures the time a PC takes to execute a set of application scripts that exercise 12 Microsoft Windows 3.1 applications. We normalize Winstone scores relative to a 386DX/25 Compaq Deskpro/M with 4MB of RAM, which has a Winstone score of 10. The Winstone scores let you compare overall system performance under Windows.

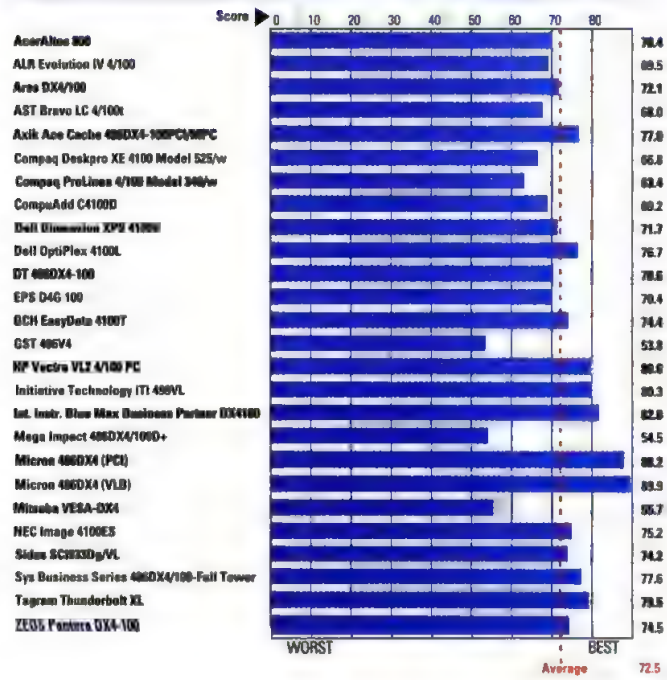
The **processor** score reflects CPU, RAM, and RAM cache performance. It is based on a large instruction mix and either the floating-point coprocessor test or the floating-point emulation test, depending on whether the PC has a coprocessor.

The **Graphics WinMark** score is a measure of PC graphics performance under Microsoft Windows 3.1. We run 66 different tests to evaluate each system's handling of the Windows GDI (Graphics Device Interface). These tests

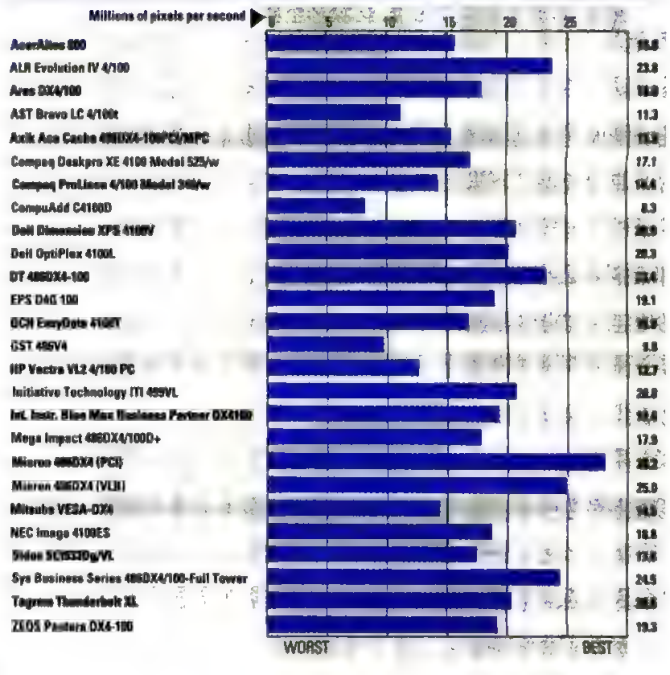
PROCESSOR



WINSTONE 94



GRAPHICS WINMARK



are based on extensive application profiling.

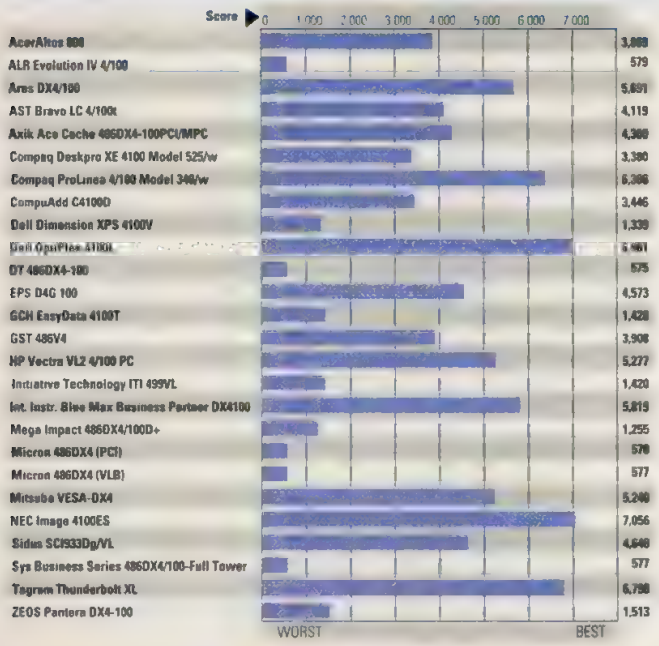
The DOS-based **video** score is a weighted harmonic mean of tests that measure 8- and 16-bit VGA write operations involving both text and graphics.

The **Disk WinMark** score reflects disk subsystem performance under Microsoft Windows. The tests use different files and file operations in a blend based on extensive profiling of applications' disk usage.

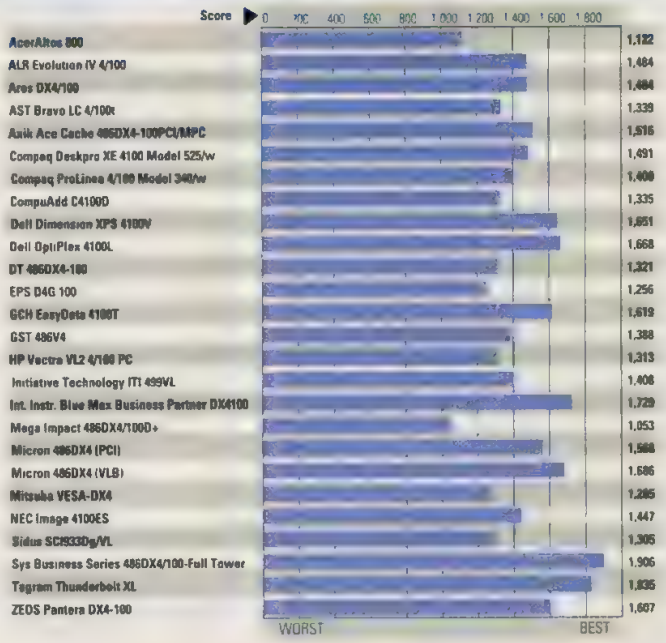
The DOS-based **disk** score gauges the performance of a PC's disk subsystem, which includes the hard disk, disk controller, and any hardware or software disk caches. Our tests use more than 100 files in six directories totaling over 30MB. The operations performed include file reads, file writes, file creation, and file deletion.

The **DOSmark** score is a composite rating derived from the processor, video, and disk scores. It indicates a PC's ability to run DOS applications quickly and efficiently.

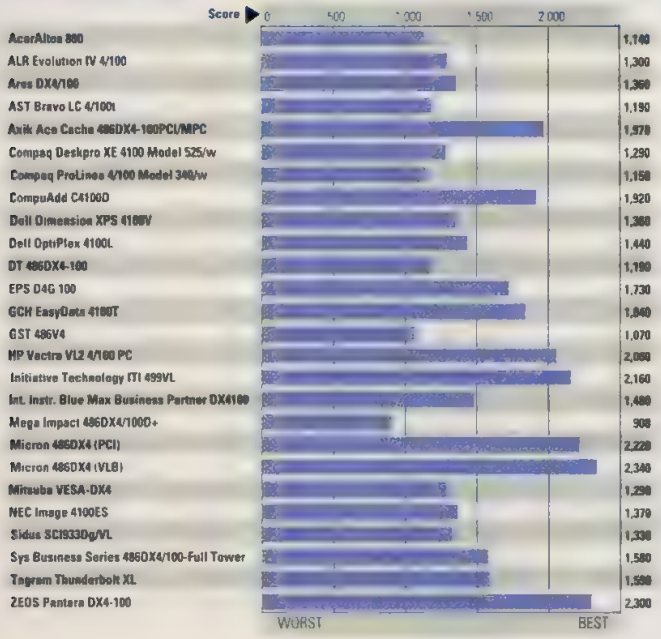
VIDEO



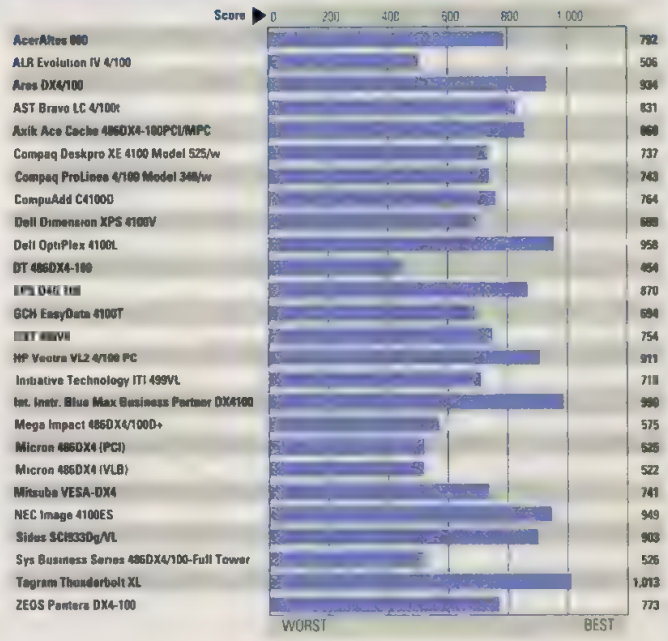
DISK



DISK WINMARK



DOSMARK



Ares Microdevelopment Inc.

• Ares DX4/100

The $3,749 Ares DX4/100 succeeds in balancing quality peripherals with solid performance, resulting in a well-rounded though slightly pricey package that should serve the needs of most users.

Our test unit, housed in a mini-tower case, came with quality peripherals, including a Pro Audio Spectrum 16 sound board and a programmable keyboard complete with Windows-based configuration software.

The motherboard, which has 16MB of RAM and 256K of external write-back cache, is well laid out, with the 100-MHz DX4 CPU off to one side so that its heat sink and fan does not preclude the use of full-length cards in the system's five ISA and two VL-Bus slots. The VL-Bus slots are occupied by a Promise Technologies disk and I/O controller card and the Genoa Systems Phantom video board, which has a Tseng ET4000 chip set.

While the Ares DX4/100 did not lead the pack in any single test, its performance was strong for the most part, especially on the DOS-based tests. Its DOSmark, processor, and DOS video scores were in the top ten, while its DOS disk score was average. Under Windows the results were less stellar, but the unit's scores on the Graphics WinMark tests were average; only its Disk WinMark test score fell below the group's average.

Ares offers a 60-day, money-back guarantee and a two-year parts, lifetime-labor warranty with one year of free on-site service from GE.—*Robert S. Anthony*

▶ FACT FILE

Ares DX4/100

List price: $3,749. **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache **Data storage:** Western Digital Caviar 540MB IDE hard disk with 128K cache, Promise DC2300 VL-Bus disk controller card, NEC MultiSpin triple-speed CD-ROM drive. **Display:** Genoa Systems Phantom 32i 8900VL VL-Bus video controller card with 2MB of VRAM, CTX CPS-1760LR 17-inch monitor with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows 3.1. **In short:** The Ares DX4/100 offers solid performance and quality components but has one of the higher price tags in this roundup.

Ares Microdevelopment Inc., 800-322-3200, 810-473-0808, fax, 810-473-4450

446 on reader service card

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	GOOD

AST Research Inc.

• AST Bravo LC 4/100t

Lackluster overall performance and a $3,250 price for the AST Bravo LC 4/100t unfortunately add up to less than meets the eye for this 100-MHz DX4 system.

The AST Bravo provides a minimal amount of room for future expansion: The motherboard lacks a ZIF socket for processor upgrades but is equipped with three standard ISA slots and one VL-Bus slot, all of which are empty thanks to the use of integrated video circuitry on the motherboard. This system is also Energy Star–compliant, as are all members of AST's Bravo line except its Bravo MT P/60 Pentium-based unit.

Overall, the AST Bravo's performance lagged behind that of the rest of the reviewed systems, particularly on the Windows-based tests. Using a video subsystem based on a Cirrus Logic chip set, the unit managed an above-average score on our DOS video tests but garnered one of the lowest scores on our Graphics WinMark tests. This video subsystem also contributed in part to the system's low Winstone score.

The AST Bravo's Disk WinMark score was below average as well; on the DOS-based disk tests, however, the unit's 540MB Quantum hard disk helped it post a score just slightly below average. The system's processor score was average for the tested group, and its DOSmark score was respectably above the average.

At a time when the cost of technical service is rising, AST comes through with a three-year warranty on parts and labor combined with one year of included on-site service.—*William P. Flanagan*

▶ FACT FILE

AST Bravo LC 4/100t

List price: $3,250 **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache **Data storage:** Quantum 540MB IDE hard disk with 1MB cache, integrated disk controller, Sony CDU33A-01 CD-ROM drive **Display:** Integrated video controller with 1MB DRAM, AST-Vision 5L 15-inch monitor with a 75-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.0, Windows 3.1. **In short:** The AST Bravo LC 4/100t has a good warranty, is Energy-Star–compliant, and integrates video circuitry to leave virtually all slots free, but it falls short on Windows performance.

AST Research Inc.; 800-876-4278, 714-727-4141; fax, 714-727-9355.

447 on reader service card

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	AVERAGE
Technical support	AVERAGE

Axik Computer Inc.

• Axik Ace Cache 486DX4-100PCI/MPC

The Axik Ace Cache 486DX4-100PCI/-MPC is an ISA- and PCI-based unit that includes some quality components, such as an NEC CD-ROM drive. But its performance was average for this test group, while its $3,898 price is well above the group's average.

Although the Axik Ace Cache is housed in a full-size tower case with eight drive bays, four PCI slots, and five ISA slots, its expansion potential is limited by the poor placement of the processor's voltage converter, which sits above the ZIF socket. As a result, two of the four PCI slots and one 16-bit ISA slot would have trouble fitting anything other than relatively short-length cards. The Axik Ace Cache will, however, accommodate up to 128MB of system memory, and its 256K cache is upgradable to 512K.

On our benchmark tests, the Axik Ace Cache was an uneven performer. Although its 500MB Quantum SCSI-2 hard disk uses a PCI-based controller, it scored only slightly above average on our DOS disk tests. It did manage, however, to

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486DX2-66	**$1795** Lease $65/mo.	**$2095** Lease $76/mo.	**$2495** Lease $90/mo.	**$3095** Lease $102/mo.
DX4-100	**$2095** Lease $76/mo.	**$2395** Lease $87/mo.	**$2795** Lease $101/mo.	**$3395** Lease $112/mo.
PENTIUM-66	**$2395** Lease $87/mo.	**$2695** Lease $98/mo.	**$3095** Lease $102/mo.	**$3695** Lease $122/mo.
PENTIUM-90	**$2595** Lease $94/mo.	**$2895** Lease $105/mo.	**$3295** Lease $109/mo.	**$3895** Lease $129/mo.
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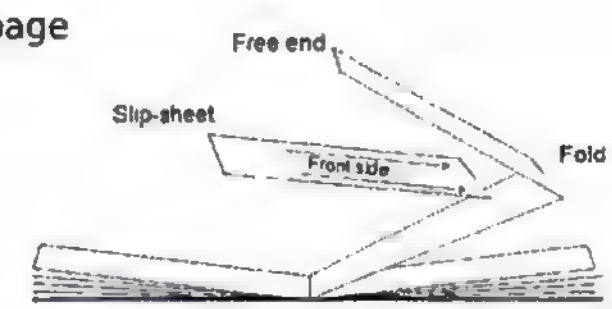
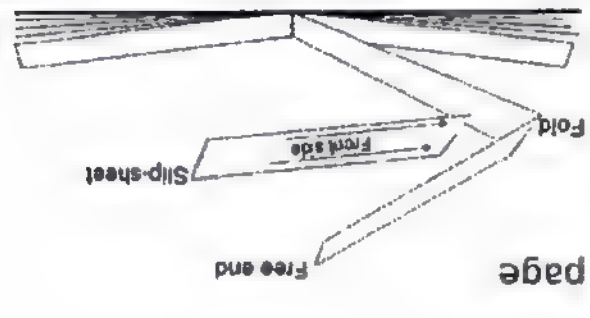
4. Close the page and slip-sheet





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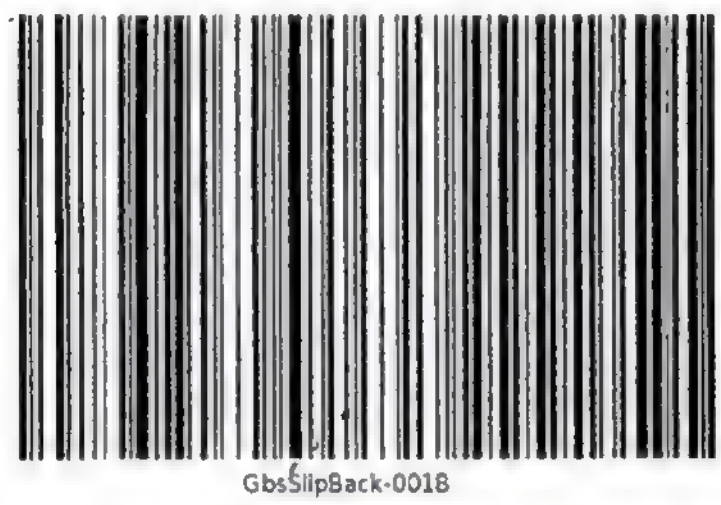

Back

1. Follow instructions on the other side

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Top computer experts at four leading publications all agree that the ZEOS Pantera is the best Pentium-processor based system available.

The ZEOS Pantera-66 earned *PC Magazine*'s Editors' Choice (April 12, 1994), *PC/Computing*'s BEST award (May 1994), *PC World*'s Best Buy (June 1994) and *Computer Shopper*'s "Top Choice" (April 1994). These prestigious awards all add up to one thing– ZEOS computers are your #1 choice.

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PC World called ZEOS 486s the "best all-around value we've seen" and "lowest price for power." In fact, they gave our 486 PCs Best Buy awards in January, February and March 1994. Wait until they see the new ZEOS Pantera 486 systems! With the hottest new technology for even better performance–they're your best 486 buy.

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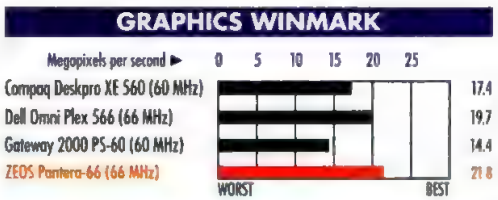
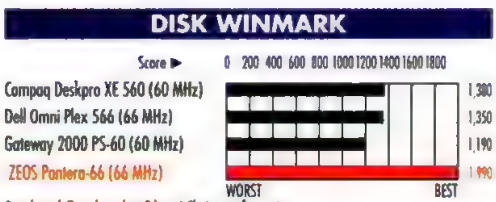
PC Magazine said the "ZEOS Pantera-66 combines quality features, good price, and high performance....

"A consistently above-average performer on all our benchmark tests, the Pantera-66 should be more than powerful enough for most. The Pantera-66 goes beyond being merely a good piece of hardware."





Benchmark Tests based on Editors' Choice configuration.

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- SVGA color monitor
- DOS, Windows for Workgroups, Microsoft Mouse

Pantera 486DX-33 **$1645**

PACKAGE #1:

- 4MB RAM
- 214MB local bus IDE hard drive, 32K cache
- 3.5" floppy drive
- PCI local bus SVGA video
- SVGA color monitor
- DOS, Windows for Workgroups, Microsoft Mouse

Pantera 486DX-33 **$1945**
486DX2-66 **$2095**

PACKAGE #2:

- 8MB RAM
- 426MB local bus IDE hard drive, 128K cache
- 2X CD-ROM drive, 3.5" floppy drive
- PCI local bus SVGA video
- SVGA color monitor
- DOS, Windows for Workgroups, Microsoft Mouse

Pantera 486DX-33 **$2093**
486DX2-66 **$2243**

PACKAGE #2MM:

- 8MB RAM
- 426MB local bus IDE hard drive, 128K cache
- 2X CD-ROM drive, 3.5" floppy drive
- Multimedia upgrade: 16-bit sound card, stereo speakers
- PCI local bus SVGA video
- SVGA color monitor
- DOS, Windows for Workgroups, Microsoft Mouse

Pantera 486DX2-66 **$2595**

TOP GUN:

- 8MB RAM
- 256K SRAM system cache
- 528MB local bus IDE hard drive, 256K cache
- 2X CD-ROM drive, 3.5" floppy drive
- Diamond Stealth 64/PCI local bus graphics with 2MB RAM
- 15" SVGA color monitor
- 14,400 bps V.32 bis send/receive fax modem
- DOS, Windows for Workgroups, Microsoft Mouse
- Choice of Lotus application

Pantera Pentium-66 **$3395**
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EDITORS' CHOICE:

- Intel Pentium Processor
- 16MB RAM, 256K cache
- 528MB local bus IDE hard drive, 256K cache
- 2X CD-ROM drive, 3.5" floppy drive
- Diamond Stealth 64/PCI local bus graphics with 2MB RAM
- 15" SVGA color monitor
- 10-bay vertical case
- DOS, Windows for Workgroups, Microsoft Mouse
- Choice of Lotus application

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PAN-PCM-9406B

CIRCLE 155 ON READER SERVICE CARD

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- MS-DOS 6.2, Windows for Workgroups 3.11, Microsoft Mouse, choice of Lotus application

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intel inside

Just look at everything you get. We started by incorporating the award-winning technology of our Pentium-processor based Pantera line into our 486 and DX4 systems. These advancements include PCI for 32-bit data transfer at a rate of 132MB per second, a PCI Local Bus IDE Controller (supporting up to four IDE devices), 3 PCI slots (including PCI local bus video) and 5 ISA slots, local bus IDE hard drives all the way to 1GB, and memory to 24MB (expandable to 128MB).

Standard are a 14" monitor, two cooling fans and a built-in surge suppressor for increased reliability, and free software.

In addition, our high-flying package reviewed in this issue of *PC Magazine* includes the Diamond Viper 32-bit video card for super-fast Windows acceleration. But, for the same price, we're now giving you the Diamond Stealth 64-bit video card with 2MB VRAM–for the *fastest* video performance possible. Your Windows and graphics performance will fly at supersonic speeds!

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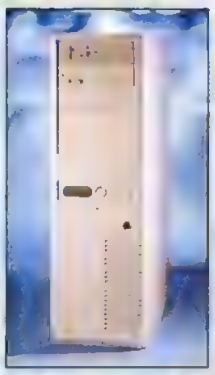
CIRCLE 125 ON READER SERVICE CARD

▶ FACT FILE

Axik Ace Cache 486DX4-100PCI/MPC



List price: $3,898. **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache. **Data storage:** Quantum 500MB SCSI-2 hard disk with 128K cache, Asus SC-200 PCI local-bus disk controller card, NEC CDR-510 CD-ROM drive with Creative Labs Sound Blaster 16 sound card. **Display:** ATI Mach32 PCI local-bus video controller card with 2MB VRAM, ADI SM-5515G 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.2, Windows for Workgroups 3.11. **In short:** The Axik Ace Cache had uneven performance and came with a price on the higher end of the scale for this roundup.

Axik Computer Inc.; 800-234-2945, 408-735-1234; fax, 408-735-1437.

448 on reader service card

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	GOOD

score well on the Disk WinMark tests, probably because of the more efficient software caching in Windows for Workgroups.

The Axik Ace Cache scored in the middle of the pack on the processor and Winstone tests. Even though the unit turned in a respectable DOS-based video score—second best for all systems using the ATI Mach32 chip set—its Graphics WinMark score fell just below the average of all systems in this roundup.

Axik Computer backs this system with a one-year warranty, with on-site service included.—*Daniel A. Begun*

Compaq Computer Corp.

• Compaq Deskpro XE 4100 Model 525/w

Although the Compaq Deskpro XE 4100 Model 525/w did not produce stellar performance on our benchmark tests, it is notable for other reasons: Its deeply integrated motherboard and advanced design make it stand out in this group. Unfortunately, so does its estimated selling price: $4,227.

The Compaq Deskpro comes with

▶ FACT FILE

Compaq Deskpro XE 4100 Model 525/w

Estimated price: $4,227. **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache. **Data storage:** Quantum 540MB IDE hard disk, integrated disk controller, Panasonic CR-503B CD-ROM drive. **Display:** Integrated local-bus video controller with 1MB VRAM, Compaq 151FS 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.2, Windows 3.1. **In short:** The Compaq Deskpro has integrated audio and Energy Star compliance, but its performance lags.

Compaq Computer Corp.; 800-345-1518, 713-378-8820; fax, 713-378-1442.

449 on reader service card

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	AVERAGE
Technical support	ABOVE AVERAGE

Compaq's Enhanced Business Audio chip set integrated on the motherboard and an external microphone adapter. Integrating the audio on the motherboard achieves an audio-ready system without sacrificing an expansion slot in the unit's slimline case, where real estate is at a premium. Energy Star compliance is also built in.

The Compaq Deskpro's performance on our tests left a little to be desired. While it was able to post an above-average score on our DOS disk tests (with a 540MB Quantum hard disk), its DOSmark score was below average, partly because of a poor processor score. The system's DOS-based video score was also a little below average, partly because of the integrated QVision chip set. Unfortunately, under Windows this performance trend did not change; scores on the Disk WinMark, Graphics WinMark, and Winstone tests were all below average.

The Compaq Deskpro offers many of today's necessary amenities—namely, onboard audio and energy conservation—but fails to measure up to the competition in terms of pure performance.—*WPF*

Compaq Computer Corp.

• Compaq ProLinea 4/100 Model 340/w

The well-designed Compaq ProLinea 4/100 Model 340/w is priced higher than the average unit in this roundup, but its $3,871 price includes a CD-ROM drive, 15-inch high-resolution monitor, and a three-year warranty. Unfortunately, it lagged behind in performance testing.

Although the Compaq ProLinea lacks some of the sophisticated technology of the Compaq Deskpro XE, such as onboard audio, it compares surprisingly well with its more expensive cousin in terms of performance. But neither machine posted the high-end scores we've come to expect from a Compaq system.

On our DOS-based tests, the unit's processor score was the lowest of the group, lagging behind the top performer by 50 percent. Its disk score was also below average.

The Compaq ProLinea's one bright spot was a very bright one, however: Its Tseng Labs ET4000 chip set gave the unit

▶ FACT FILE

Compaq ProLinea 4/100 Model 340/w

List price: $3,871. **Processor/memory:** Intel DX4/100, 16MB RAM, 128K external cache. **Data storage:** Seagate 341MB IDE hard disk with 256K cache, integrated disk controller, Panasonic CR-503-B CD-ROM drive. **Display:** Integrated local-bus video controller with 1MB VRAM, Compaq 151FS 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.2, Windows 3.1. **In short:** This unit was not a top performer, but Compaq's reputation makes it worth considering.

Compaq Computer Corp.; 800-345-1518, 713-378-8820; fax, 713-378-1442.

450 on reader service card

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	POOR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	AVERAGE
Technical support	ABOVE AVERAGE

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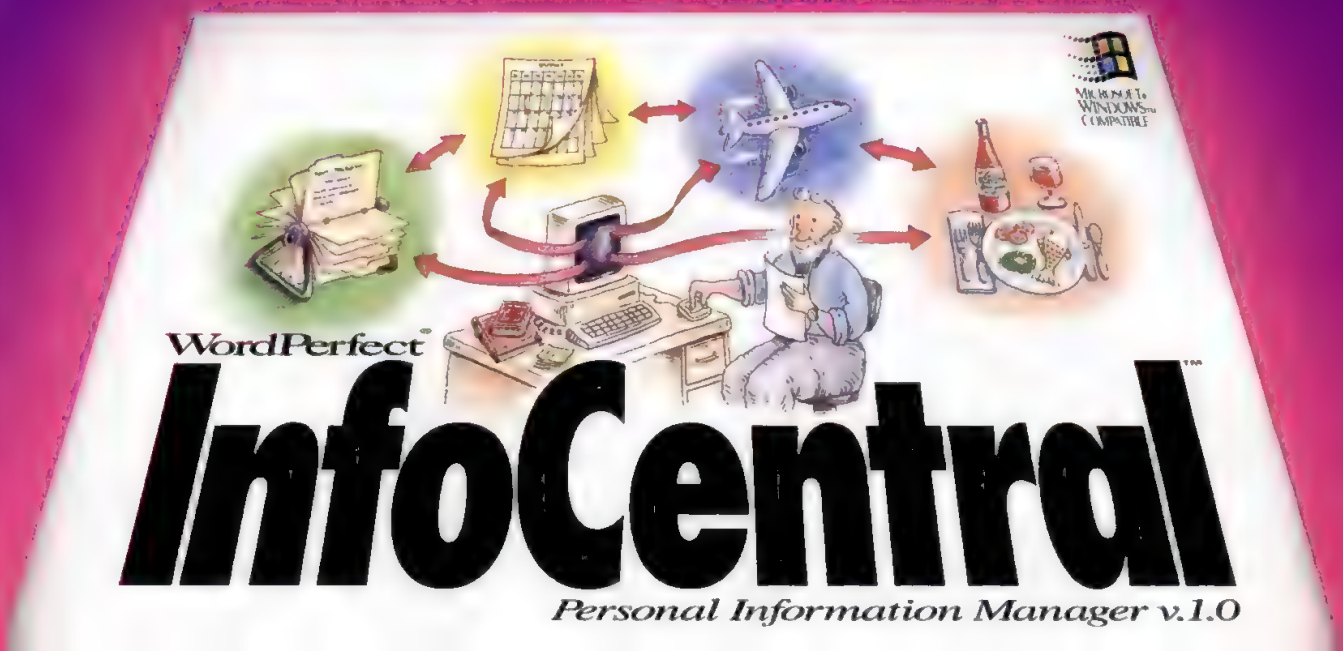


a DOS-based video score that was in the top ten and helped boost its DOSmark score to average. Unfortunately, the unit's Windows performance had no similar bright spots. Its Graphics WinMark score was among the lowest of the group; the Disk WinMark and Winstone scores were below average as well.

The price and the consistent quality of Compaq's systems in general would make the Compaq ProLinea attractive to a newcomer. But a seasoned computer user may shortly be yearning for more.—*WPF*

CompuAdd Computer Corp.

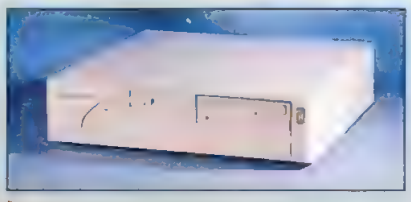
• CompuAdd C4100D

For $3,110, the CompuAdd C4100D is built around a Micronics motherboard that is highly integrated with quality components. Unfortunately, the system still comes up short on performance.

The Micronics motherboard had the disk controller and the video chip set integrated onto it, leaving the unit's one VL-Bus slot open. Although the processor remained cool, over time the voltage converter required to allow the 3.3-volt CPU to operate on the 5.0-volt motherboard became very hot. New implementations of this converter will replace this design, but in the meantime one would have to wonder if this excess heat will have any negative effects on the system.

Our benchmark tests showed that the CompuAdd C4100D lagged in both the DOS and Windows arenas. The 340MB Western Digital hard disk was the one bright spot in this unit's performance, helping the system notch a top-ten score on our Disk WinMark tests. Unfortunately, the disk subsystem yielded a poor showing on the DOS-based disk test. The CompuAdd unit, with its integrated ATI Mach32 video chip set, posted the lowest score in this roundup on our Graphics WinMark tests and a below-average score on the DOS video tests. The unit's processor and Winstone scores were below average as well.

Although the price of this system is more than reasonable, one can't help feeling that with its next generation, the CompuAdd C4100D will hit the nail on the head in terms of DX4 performance.—*WPF*



▶ FACT FILE

CompuAdd C4100D

List price: $3,110. **Processor/memory:** Intel DX4/100, 16MB RAM, 128K external cache **Data storage:** Western Digital 340MB IDE hard disk with 128K cache, integrated disk controller, Mitsumi CRMC-FX001D CD-ROM drive **Display:** Integrated video controller with 1MB DRAM, CompuAdd TE1564M 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows for Workgroups 3.11. **In short:** The CompuAdd C4100D has a reasonable price, quality components, and good Windows disk performance, but the rest of its performance wasn't up to par.

CompuAdd Computer Corp.; 800-627-1961; fax, 512-331-2862.

451 on reader service card

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	GOOD
Expandability	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	BELOW AVERAGE
Repair service	AVERAGE
Technical support	ABOVE AVERAGE

Dell Computer Corp.

• Dell Dimension XPS 4100V

Although the performance is not quite up to speed compared with some of the other systems in this roundup, the $3,299 Dell Dimension XPS 4100V does have an advanced design that offers a suprising amount of expansion potential.

Five drive bays and seven slots give the Dell Dimension 4100V enough expansion room to rival almost any tower. However, two of the ISA expansion slots can accommodate only half-length cards because they are blocked by the system's four SIMM slots.

On our DOS-based benchmark tests, the Dell Dimension 4100V turned out to be mostly a below-average performer. But it did have two bright spots in performance: Its processor score was average, and its disk score was slightly above average. On the DOS video tests the unit's Weitek P9000-based Diamond Viper VLB video card did not help matters: The Dell Dimension 4100V posted a score that was well below the test group's average, which contributed in part to a low DOSmark score. On the Graphics WinMark tests, however, this unit placed among the top ten, showing the video subsystem's penchant for a Windows environment. Though the Dell Dimension 4100V's Disk WinMark score was below average, the unit still managed an average score on the Winstone test.

▶ FACT FILE

Dell Dimension XPS 4100V

List price: $3,299. **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache. **Data storage:** Quantum 502MB IDE hard disk, integrated disk controller, Panasonic CDR-563 CD-ROM drive **Display:** Diamond Viper VLB VL-Bus video controller card with 2MB VRAM, Dell UltraScan 15VS 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows 3.1 **In short:** The Dell Dimension XPS 4100V offers good expansion possibilities and a reasonable price, but its performance doesn't measure up to that of other systems in this roundup.

Dell Computer Corp.; 800-289-3355, 512-338-4400; fax, 512-728-3653

452 on reader service card

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

Although the Dell OptiPlex 4100L, also tested in this roundup, had better performance overall, the Dell Dimension 4100V offers the user a bit more potential to tweak and upgrade the system via its two VESA local-bus slots.—*WPF*

Dell Computer Corp.

• Dell OptiPlex 4100L

A high-powered personal computer, the $3,329 Dell OptiPlex 4100L is an excellent system for a newcomer to the world of PCs who wants to run DOS and Windows applications equally well. Because of limited expansion possibilities, however, it may be too confining for an experienced user.

The memory and external cache options will make the new user feel confident that he or she can always go to

Dell and get any upgrades needed. But a more experienced user might feel constrained by the absence of local-bus slots, which could restrict future expansion. In addition, one of the system's three ISA slots cannot accept a full-length card because it is blocked by the processor's heat sink.

The Dell OptiPlex 4100L turned out to be an excellent all-around performer that scored equally well on DOS and Windows tests.

On our benchmark tests, the Dell OptiPlex 4100L turned out to be an exceptional all-around performer that scored equally well on our DOS- and Windows-based tests. The combination of

▶ FACT FILE

Dell OptiPlex 4100L

List price: $3,329. **Processor/memory:** Intel DX4/100, 16MB RAM, 128K external cache **Data storage:** Seagate 452MB IDE hard disk with 256K cache, integrated disk controller, Panasonic CDR-563 CD-ROM drive. **Display:** Integrated local-bus video controller with 2MB VRAM, Dell UltraScan 15ES 15-inch monitor with a 76-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.2, Windows 3.1. **In short:** The Dell OptiPlex 4100L is a good system for both DOS and Windows use, offering new users one-stop shopping. Experienced users may feel a bit restricted by the lack of local-bus slots, however.

Dell Computer Corp; 800-289-3355, 512-338-4400; fax, 512-728-3653.

453 on reader service card

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

▶ SUMMARY OF FEATURES CONTINUES

100-MHz DX4 PCs

List price (tested configuration) We report the price for the system configuration that we tested. Some vendors provide an estimated selling price instead of a list price to reflect what customers should expect to pay.

Hard disk capacity and interface describes the hard disk subsystem that came with our tested unit. In this roundup, each system used either an IDE or a SCSI-2 interface between the hard disk and the controller.

Dealers/Direct-distribution channel Some vendors sell only through authorized dealers or company-owned stores. Others sell their PCs directly to users via mail order or combine both methods.

Case style greatly affects a system's expansion potential. Keep in mind that a small, well-designed system may rival a larger but poorly arranged one.

Power supply (and number of connectors) We list the wattage of each system's power supply and the number of connectors for each. The number of connectors determines how many devices the PC can power.

DOS/Windows version We asked all vendors to preinstall DOS and Microsoft Windows on their systems before shipping them to us. We list which versions of these packages each vendor included.

Warranty All vendors in this roundup offer at least one year on parts and labor.

On-site service charges vary greatly from system to system. If a vendor offers on-site service as an option, we report the cost of purchasing that option for one year.

Bus architecture (primary, secondary) refers to the buses that connect the I/O slots to the CPU.

Processor upgrade path Processors can be seated in several different types of sockets, which determine a computer's upgradability. These sockets can be standard or ZIF (zero insertion force). You can also upgrade via processor card.

We indicate the **BIOS version (or date)** for each system. The BIOS, which performs a computer's initial boot and test routines, may affect a unit's performance on our benchmark tests.

Flash memory stores the BIOS code, replacing conventional ROM storage for this purpose. Unlike ROM, flash memory can handle both reads and writes, making the BIOS upgradable.

External RAM cache We list the range of external RAM cache that each computer can support. For systems that come with a set amount of RAM cache that is not upgradable, we report that amount of external RAM cache.

Cache architecture In a *direct-mapped* cache, each address in main memory is assigned to one location in the cache. Each location in the cache, however, can accept data from many main memory addresses—though not from more than one at once. This one-to-many relationship between main memory and cache often results in bottlenecks. *Two-way set-associative caches* relieve this problem somewhat by allowing each address in main memory to occupy one of two locations in the cache; the penalty is that the cache must be searched to find in which of the two locations data is located. *Four-way set-associate cache* is similar, with each address in main memory corresponding to four locations in the cache.

Cache write design *Write-through* caches write updated data to both cache and main memory. Although relatively easy to implement, a write-through cache can introduce delays when the processor must wait to complete writes to the slower main memory. For *write-back cache*, data that has been changed is written back to the cache; main memory is updated only when the cached data is replaced, thus minimizing delays.

Disk controller location The disk controller circuitry can be located either on a card or on the motherboard.

CD-ROM drive Since all of the tested systems were required to include a CD-ROM drive, we list the CD-ROM drive manufacturer and model that comes in each system.

Display circuitry location The display circuitry is located either on a card or on the motherboard.

▶ SUMMARY OF FEATURES CONTINUES

100-MHz DX4 PCs

Products listed in alphabetical order ■ = YES □ = NO	AcerAltos 800	ALR Evolution IV 4/100	Ares DX4/100	AST Bravo LC 4/100t	Axik Ace Cache 486DX4-100PCI/MPC	Compaq Deskpro XE 4100 Model 525/w	Compaq ProLinea 4/100 Model 340/w	CompuAdd C4100D
List price (tested configuration)	$5,112	$4,494	$3,749	$3,250	$3,898	$4,227 (estimated)	$3,871 (estimated)	$3,110
Hard disk capacity and interface	520MB SCSI-2	425MB IDE	540MB IDE	540MB IDE	500MB SCSI-2	540MB IDE	341MB IDE	340MB IDE
Dealers/Direct-distribution channel	■■	■■	□■	■□	□■	■□	■■	□■
Case style	Mini-tower	Small-footprint	Mini-tower	Desktop	Tower	Slimline	Slimline	Slimline
Power supply (and number of connectors)	200W (4)	200W (4)	250W (5)	145W (4)	250W (6)	145W (4)	145W (4)	200W (6)
DOS, Microsoft Windows version	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.0, Windows 3.1	DOS 6.2, Windows for Workgroups 3.11	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows for Workgroups 3.11
Warranty	1 year	5 years parts, 15 months labor	2 years parts, lifetime labor	3 years	1 year	3 years	3 years	1 year
On-site service charge	Included (1 year)	$9.95 (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)
Processor and Memory								
Bus architecture (primary, secondary)	EISA, VL-Bus	ISA, VL-Bus	ISA, VL-Bus	ISA, VL-Bus	ISA, PCI	ISA, proprietary local-bus	ISA, proprietary local-bus	ISA, VL-Bus
Motherboard manufacturer	Acer	ALR	Asus	AST	Axik	Compaq	Compaq	Micronics
Chip set manufacturer	OPTi	VLSI	SIS	VLSI	SIS	Compaq	VLSI	Micronics
Processor upgrade path	Processor card	ZIF	ZIF	Standard	ZIF	ZIF	Standard	ZIF
BIOS version (or date)	Acer (1/24/94)	Phoenix 1.02.07M	Award 4.50G	IBM/AST Bravo	AMI (8/8/93)	Compaq (1/12/94)	Compaq (3/4/94)	Phoenix 0.10 mpower4-04
Flash memory/16550 UART support	■□	■■	■□	■□	■■	■■	■■	■■
Installable system RAM	4MB–64MB	4MB–52MB	4MB–64MB	4MB–64MB	1MB–128MB	8MB–32MB	8MB–100MB	4MB–64MB
External RAM cache	256K–1MB	256K	0–1MB	64K–256K	0–512K	256K	128K	32K–256K
Cache architecture	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Two-way set-associative	Direct-mapped	Direct-mapped
Cache write design	Write-back	Write-back	Write-back	Write-back	Write-back	Write-through	Write-back	Write-back
Components								
Available hard disk sizes	520MB–2GB	210MB–1.3GB	212MB–1.8GB	270MB–540MB	120MB–1.7GB	170MB–1.05GB	170MB–1.05GB	212MB–2GB
Disk controller location	Motherboard	VL-Bus card	VL-Bus card	Motherboard	PCI card	Motherboard	Motherboard	Motherboard
Accessible drive bays (5.25", 3.5")	3, 3	2, 1	4, 0	2, 1	4, 0	1, 1	1, 1	2, 1
Internal drive bays (5.25", 3.5")	0, 2	0, 1	2, 0	0, 2	2, 2	0, 1	0, 1	0, 1
Floppy disk drives	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB
CD-ROM drive	Sony CDU541	Plextor DM-3028	NEC MultiSpin 3X	Sony CDU33A-01	NEC CDR-510	Panasonic CR-503B	Panasonic CR-503B	Mitsumi CRMC-FX001D
ISA, EISA, MCA slots	0, 6, 0	3, 0, 0	5, 0, 0	3, 0, 0	5, 0, 0	3, 0, 0	3, 0, 0	4, 0, 0
VL-Bus, PCI, proprietary local-bus slots	2, 0, 0	2, 0, 1	2, 0, 0	1, 0, 0	0, 4, 0	0, 0, 0	0, 0, 0	1, 0, 0
Parallel, serial, mouse ports	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 1	1, 2, 0	1, 1, 1	1, 2, 1	1, 2, 1
Display circuitry location	VL-Bus card	VL-Bus card	VL-Bus card	Motherboard	PCI card	Motherboard (proprietary local-bus)	Motherboard (proprietary local-bus)	Motherboard
Video chip set manufacturer	ATI	Matrox	Tseng Laboratories	Cirrus Logic	ATI	Compaq	Tseng Laboratories	ATI
Video RAM	2MB	2MB	2MB	1MB	2MB	1MB	1MB	1MB

ALR—Advanced Logic Research Inc., ATI—ATI Technologies Inc., EPS—EPS Technologies Inc., HP—Hewlett-Packard Co., IMS—Integrated Micro Solutions, SIS—Silicon Integrated Systems Corp., VLSI—VLSI Technology Inc.

an average processor score and top-five scores on the DOS disk and DOS video tests (aided by the unit's 452MB Seagate hard disk and Tseng ET4000-based proprietary local-bus video) boosted the DOSmark score to third place. On the Windows-based benchmark tests the Dell OptiPlex 4100L's scores were also good, highlighted by top-ten finishes on the Winstone and Graphics WinMark tests and a competitive score on the Disk WinMark tests.

The Dell OptiPlex 4100L is a good system for new users, offering them the confidence that comes with one-stop shopping and from dealing with an established company such as Dell.—*WPF*

Diamond Technologies Inc.

• DT 486DX4-100

Diamond Technologies' DT 486DX4-100 mini-tower system sells for an admirable $2,965, well below the average price for this test group. But while it incorporates several top-shelf components, including a Matrox Power Graphics video adapter, a hard disk caching controller, and an NEC CD-ROM drive, it doesn't perform as well as some reviewed systems that cost less.

One would think that using a VL-Bus caching disk controller with 2MB of RAM would give the DT 486DX4-100 an advantage over systems with integrated or noncached controllers, but that's not the case here. On our DOS-based benchmark tests the DT 486DX4-100 proved to be one of the weakest systems in this roundup. The disk subsystem, which used a 345MB Maxtor hard disk, posted a DOS disk score that was among the lowest of the group. The unit's processor and DOSmark scores were also well below average for the group. As expected, the Matrox video card performed poorly on our DOS-based video tests but brilliantly on our Windows tests, which helped the DT 486DX4-100 post an exceptionally high Graphics WinMark score. The system's Winstone and Disk WinMark scores were below average but not as far below the

▶ FACT FILE

DT 486DX4-100

List price: $2,965. **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache. **Data storage:** Maxtor 345MB SCSI-2 hard disk with 64K cache, Tekram Technology DC-800 VL-Bus disk controller card with 2MB cache, NEC CDR 510 CD-ROM drive. **Display:** Matrox MGA VLB/2 VL-Bus video controller card with 2MB VRAM, KFC CA1507.15-inch monitor with a 70-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.0, Windows 3.1. **In short:** Despite a reasonable price and some high-end components, the DT 486DX4-100 does not come through in terms of performance

Diamond Technologies Inc.; 800-989-7253, 714-533-9910; fax, 714-533-7805.

454 on reader service card

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	GOOD
Expandability	EXCELLENT

average as the scores on the DOS tests.

Although it has some high-end engineering, the DT 486DX4-100 is overmatched in this roundup. Systems from companies such as Micron and Tagram were able to set quality Windows and DOS performance standards using many of the same components that Diamond Technologies uses.—*WPF*

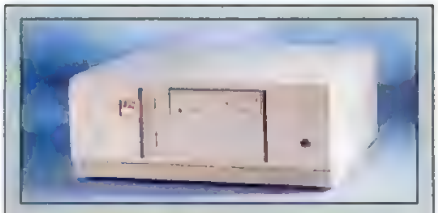
EPS Technologies Inc.

• EPS D4G 100

EPS Technologies builds systems that give the buyer value. The $2,595 EPS D4G 100 offers solid performance in both the Windows and DOS arenas at the lowest price in this roundup. It is also Energy Star–compliant.

The system's small-footprint desktop case is sturdy and well built. Generally, the internal elements are neatly laid out, though you won't be able to use full-length cards in three of the the system's four ISA expansion slots due to the placement of the processor—a common design shortcoming found in many systems in this roundup.

By using the motherboard's two VL-Bus slots for the hard disk controller card and video card, EPS put this system right



▶ FACT FILE

EPS D4G 100

List price: $2,595 **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache. **Data storage:** Maxtor 345MB IDE hard disk with 128K cache, DTC DTC2278VL VL-Bus disk controller card, Mitsumi CRMC-FX001D CD-ROM drive with Mozart sound card and Labtec CS-550 speakers. **Display:** Orchid Kelvin 64 VLB VL-Bus video controller card with 2MB DRAM, EPS EPS1560LR 14-inch monitor with a 70-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Microsoft Windows for Workgroups 3.11. **In short:** The EPS D4G 100 combines performance and value with the lowest price in this roundup.

EPS Technologies Inc.; 800-447-0921, 605-966-5586, fax, 605-966-5482

455 on reader service card

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	GOOD

in the thick of things in terms of performance. With scores that were slightly above average in almost every category, the EPS D4G 100 proved to be a competitive system that should satisfy all but the most ardent power users. The only exception arose on our DOS-based tests, where the disk subsystem, which uses a 345MB Maxtor hard disk, caused the unit to post a below-average DOS disk score. The EPS D4G 100 did, however, manage an above-average Disk WinMark score.

The video subsystem, based on a Cirrus Logic chip set, helped the unit achieve better-than-average scores on both the DOS video tests and the Graphics WinMark tests. Overall, the EPS D4G 100 yielded processor and DOSmark scores that were above average but fell short on the Winstone test.

The EPS D4G 100 is a strong system that is offered at an excellent price. —*WPF*

GCH Systems Inc.

• GCH EasyData 4100T

By including VL-Bus as well as PCI expansion slots, the $3,495 GCH EasyData 4100T gives the user the luxury of choosing either of these local-bus alternatives—or both. But despite this unparalleled degree of flexibility, the GCH EasyData doesn't come up to the mark in terms of performance and overall design.

Housed in a mini-tower case, the GCH EasyData looks impressive on the outside but has a cramped internal layout. To reach the expansion slots, you have to remove the four screws that hold the hard disk cage in place directly above the slots. In addition, the unit's three 16-bit ISA slots can accommodate only short-length cards due to the height of the voltage converter. The unit accommodates up to 96MB of system memory, and its 256K of external RAM cache is expandable to 512K.

The GCH EasyData's performance on our benchmark tests was mixed. Its processor score was below average, as was its DOS video score. Its Graphics WinMark score was the lowest of all the tested systems that used the Weitek Power 9000 chip. However, the unit did achieve above-average scores on our DOS disk and Disk WinMark tests. These results were influenced by the GHC EasyData's 8MB VL-Bus caching disk controller, as well as Windows for Workgroups' advanced software disk caching routine and its 32-bit file access capability. The unit's

▶ FACT FILE

GCH EasyData 4100T

List price: $3,495. **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache **Data storage:** Conner 425MB IDE hard disk, Buslogic 410A VL-Bus disk controller card with 8MB cache, Sony CDU-33A CD-ROM drive **Display:** Diamond Viper PCI local-bus video controller card with 2MB VRAM, CTX 1562GM 15-inch monitor with a 87-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.2, Windows for Workgroups 3.11. **In short:** The GCH EasyData offers flexibility via both PCI and VL-Bus slots but doesn't deliver in terms of performance.

GCH Systems Inc.; 800-366-4560, 415-968-3400; fax, 415-960-0594.

456 on reader service card

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	GOOD

SUMMARY OF FEATURES

CONTINUES

Products listed in alphabetical order ■ = YES □ = NO	Dell Dimension XPS 4100V	Dell OptiPlex 4100L	DT 486DX4-100	EPS D4G 100	GCH EasyData 4100T	GST 486V4	HP Vectra VL2 4/100 PC
List price (tested configuration)	$3,299	$3,329	$2,965	$2,595	$3,495	$2,698	$3,996
Hard disk capacity and interface	502MB IDE	452MB IDE	345MB SCSI-2	345MB IDE	425MB IDE	341MB IDE	325MB IDE
Dealers/Direct-distribution channel	□■	□■	□■	□■	□■	■■	■□
Case style	Desktop	Slimline	Mini-tower	Small-footprint	Mini-tower	Mini-tower	Slimline
Power supply (and number of connectors)	200W (5)	146W (5)	230W (4)	145W (4)	220W (4)	250W (5)	100W (3)
DOS, Microsoft Windows version	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.0, Windows 3.1	DOS 6.2, Windows for Workgroups 3.11	DOS 6.2, Windows for Workgroups 3.11	DOS 6.2, Windows 3.1	DOS 6.2, Windows for Workgroups 3.11
Warranty	1 year	1 year	15 months	3 years parts, 1 year labor	1 year	1 year	3 years
On-site service charge	Included (1 year)	Included (1 year)	$75.00 (1 year)	Included (1 year)	Included (1 year)	N/A	Included (1 year)
Processor and Memory							
Bus architecture (primary, secondary)	ISA, VL-Bus	ISA, proprietary local-bus	ISA, VL-Bus	ISA, VL-Bus	ISA, PCI and VL-Bus	ISA, VL-Bus	ISA
Motherboard manufacturer	Intel	Dell	Diamond Technologies	EPS	Lexar	Micronics	HP
Chip set manufacturer	Micronics	Headland	SIS	SIS	IMS	Micronics	VLSI
Processor upgrade path	Standard	ZIF	ZIF	ZIF	ZIF	ZIF	ZIF
BIOS version (or date)	Phoenix 0.10 P02	Phoenix (2/23/94)	Award (2/2/94)	Award (2/24/94)	AMI (6/6/92)	Phoenix JX30GC-P01	Phoenix (2/1/94)
Flash memory/16550 UART support	■■	■■	□■	■□	■□	■■	■■
Installable system RAM	4MB–64MB	4MB–64MB	1MB–64MB	4MB–128MB	1MB–96MB	4MB–64MB	1MB–32MB
External RAM cache	0–256K	0–128K	128K–1MB	64K–512K	128K–512K	0–256K	0–256K
Cache architecture	Direct-mapped	Direct-mapped	Four-way set-associative	Direct-mapped	Direct-mapped	Direct-mapped	Four-way set-associative
Cache write design	Write-back	Write-through	Write-back	Write-back	Write-back	Write-back	Write-back
Components							
Available hard disk sizes	270MB–1GB	210MB–1GB	210MB–7.2GB	245MB–3GB	240MB–2.1GB	341MB–2GB	325MB
Disk controller location	Motherboard	Motherboard	VL-Bus card	VL-Bus card	VL-Bus card	VL-Bus card	Motherboard
Accessible drive bays (5.25", 3.5")	3, 0	2, 0	3, 2	2, 2	5, 0	3, 0	1, 1
Internal drive bays (5.25", 3.5")	0, 2	0, 1	0, 1	2, 0	0, 2	0, 2	2, 0
Floppy disk drives	Dual 1.2MB/1.44MB	Dual 1.2MB/1.44MB	1.44MB	1.44MB	1.44MB	Dual 1.2MB/1.44MB	1.44MB
CD-ROM drive	Panasonic CDR-563	Panasonic CDR-563	NEC CDR 510	Mitsumi CRMC-FX001D	Sony CDU-33A	Matsushita CR-562-B	HP D2886-60001
ISA, EISA, MCA slots	5, 0, 0	3, 0, 0	5, 0, 0	4, 0, 0	3, 0, 0	5, 0, 0	4, 0, 0
VL-Bus, PCI, proprietary local-bus slots	2, 0, 0	0, 0, 0	2, 0, 0	3, 0, 0	2, 3, 0	2, 0, 0	0, 0, 0
Parallel, serial, mouse ports	1, 2, 1	1, 2, 1	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1
Display circuitry location	VL-Bus card	Motherboard (proprietary local-bus)	VL-Bus card	VL-Bus card	PCI card	VL-Bus card	Motherboard
Video chip set manufacturer	Weitek	Tseng Laboratories	Matrox	Cirrus Logic	Weitek	Cirrus Logic	Cirrus Logic
Video RAM	2MB	2MB	2MB	2MB	2MB	1MB	1MB

N/A—Not applicable: The product does not have this feature.
ALR—Advanced Logic Research Inc., ATI—ATI Technologies Inc., EPS—EPS Technologies Inc., HP—Hewlett-Packard Co., IMS—Integrated Micro Solutions, SIS—Silicon Integrated Systems Corp., VLSI—VLSI Technology Inc.

Winstone scores were also above average for the test group.

If the flexibility of having both PCI and VL-Bus is paramount and you don't mind limited expandability and less-than-stellar performance, then the GCH EasyData is the system for you.—*DAB*

Golden Star Technology

GST 486V4

Golden Star Technology's $2,698 GST 486V4 comes packed with today's hottest goodies: a CD-ROM drive, sound card, and a selection of CD-ROM software titles. But the GST 486V4's attractive price is balanced by the system's dismal performance and poorly-laid-out motherboard.

Inside the GST 486V4's mini-tower case you'll find a processor with a 256K external write-back cache, a 341MB hard disk attached to a Promise VL-Bus disk controller with 512K of disk cache, a Creative Labs SoundBlaster Pro Deluxe 16 sound card, a Diamond SpeedStar Pro video board with 1MB of VRAM, and four free ISA slots.

Don't let the number of free slots fool you, however: Two of the GST 486V4's ISA slots are blocked by the SIMM banks and one is blocked by the CPU's heat sink; hence only one of these slots can handle a full-length expansion card. Future memory upgrades may also prove to be a hassle, since all four SIMM banks were filled with 4MB SIMMs in our 16MB test configuration.

The GST 486V4's performance on our Windows-based benchmark tests was disappointing. It finished dead last on our Winstone test and second to last on our Disk WinMark and Graphics WinMark tests. On the DOS side of the house, the GST 486V4's performance was a bit better: Its DOS video score was above the test group's average but its processor test score was just below.

Our test system included Golden Star's CD upgrade package, which consists of a CD-ROM drive and four CD software

▶ FACT FILE

GST 486V4

List price: $2,698. **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache. **Data storage:** Western Digital 341MB IDE hard disk with 128K cache, Promise Technologies DC9914 VL-Bus disk controller card with 512K cache, Matsushita CR-562-B CD-ROM drive **Display:** Diamond SpeedStar Pro VL-Bus video controller card with 1MB VRAM, Sceptre 615GL 15-inch monitor with a 75-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows 3.1 **In short:** The GST 486V4 has some nice extras but yielded poor performance.

Golden Star Technology; 714-739-0106; fax, 714-739-8291.

457 on reader service card

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	FAIR
Expandability	GOOD

titles. But these extras cry out for a speedy Windows PC, which the GST 486V4 unfortunately is not.—*Carol Venezia*

Hewlett-Packard Co.

• HP Vectra VL2 4/100 PC

Hewlett-Packard's HP Vectra VL2 4/100 PC is a high-performance system that is worth its $3,996 price in view of what you get.

This Energy Star–compliant PC comes in a slimline desktop case that HP keeps uncluttered by integrating all the I/O, video, and disk controllers. The CPU is in a ZIF socket. Only one of four drive bays is free. The four ISA slots are unobstructed, and all but one (used by the CD-ROM drive controller) are free.

The HP Vectra VL2 performed very well on most of our tests. Its integrated Cirrus Logic video chip set helped the system make a strong showing on our DOS video test, though it wasn't as successful in Windows. Despite that—and with the help of the Quantum drive with its integrated controller—the HP Vectra VL2 managed fifth place on both our Winstone and Disk WinMark tests. The high Disk WinMark score was probably influenced by the software caching abilities of

▶ FACT FILE

HP Vectra VL2 4/100 PC

List price: $3,996 **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache **Data storage:** Quantum 325MB IDE hard disk with 1MB cache, integrated disk controller, HP D2886-60001 CD-ROM drive **Display:** Integrated video controller with 1MB VRAM, Samtron D2804A-60011 14-inch monitor with a 60-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows for Workgroups 3.11. **In short:** The HP Vectra VL2 combines a clean and functional internal layout with top-notch performance on most of our DOS and Windows benchmark tests.

Hewlett-Packard Co.; 800-752-0900, 303-635-1000; fax, 800-333-1917.

458 on reader service card

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

Windows for Workgroups 3.11. Without the aid of the Windows-based 32-bit software cache the drive subsystem didn't perform as well in DOS, but the excellent DOS video score helped this unit achieve an above-average DOSmark score. Processor test results were also above average. Earlier scores published in the First Looks section of our April 12, 1994, issue were incorrectly low because of a testing error.

HP has put together a marvelously powerful system that is priced high but will still appeal to those who need extra processing power.—*AY*

Initiative Technology Inc.

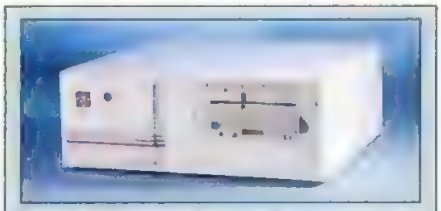
• ITI 499VL

Initiative Technology's ITI 499VL delivers a lot of performance and moderate expansion possibilities. But at a list price of $4,495, it isn't a strong value compared with other members of this 100-MHz group.

This sturdy system comes with three of its six drive bays empty (five of the six are front accessible)—not bad in a desktop system. Our unit also had three of its four SIMM banks empty. Expansion slots are plentiful: five ISA slots, only one of which is taken by the CD-ROM controller. Two additional ISA slots have VL-Bus extensions; one of them is filled by the Diamond Viper VLB video controller card with 2MB of VRAM. There is one problem, however: Because of the placement of the SIMM banks and CPU, four of the ISA-only slots cannot accept full-size expansion cards.

During testing the ITI 499VL emerged as a strong performer, especially on our Windows-based performance tests. Its Disk and Graphics WinMark scores were both above average, and its processor score was one of the highest in this roundup. The system's Winstone performance remained consistent with its performance on other Windows tests and on the processor tests, putting it among the top scorers in this roundup. On our DOS-based benchmark tests, the ITI 499VL's disk score was respectable, but its DOS video score was far below the group's average. Its good processor score, however, helped keep the DOSmark score within the average range.

The ITI 499VL is an excellent though expensive choice for those who will be working primarily in Windows.—*AY*



▶ FACT FILE

ITI 499VL

List price: $4,495 **Processor/Memory:** Intel DX4/100, 16MB RAM, 256K external cache. **Data storage:** Conner Peripherals 546MB IDE hard disk with 256K cache, integrated disk controller, NEC MultiSpin 3xi CD-ROM drive **Display:** Diamond Viper/VL VL-Bus video controller card with 2MB VRAM, NEC 3V 15-inch monitor with a 60-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows for Workgroups 3.11. **In short:** While the ITI 499VVL performed admirably on most of our benchmark tests, its appeal is overshadowed by its low DOS video score and high price.

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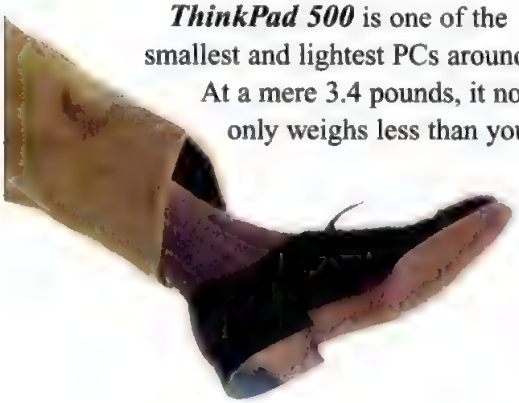

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• 512KB video memory	• 1MB video memory
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• VESA local bus video	• VESA local bus video
• 1MB video memory	• 1MB video memory
• IBM Enhanced 101-Key Keyboard & Mouse	• IBM Enhanced 101-Key Keyboard & Mouse
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- 1MB video memory
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i486SX 33MHz (IBM Lease Price $61/month)[2] **$1689**
i486DX2 25/50MHz (IBM Lease Price $76/month)[2] **$2079**

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- 14V Color Monitor
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- VESA local bus video
- 1MB video memory
- 8 ISA slots, 6 bays
- 3.5" 1.44MB disk drive
- DOS and Windows
- IBM Enhanced 101-Key Keyboard & Mouse

i486DX2 25/50MHz (IBM Lease Price $86/month)[2] **$2359**
i486DX2 33/66MHz (IBM Lease Price $101/month)[2] **$2779**

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- 1MB video memory
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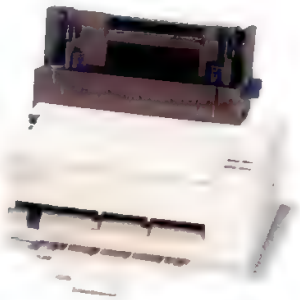

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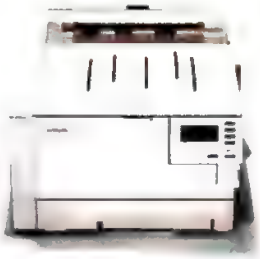

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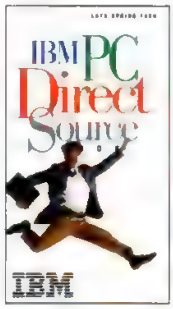

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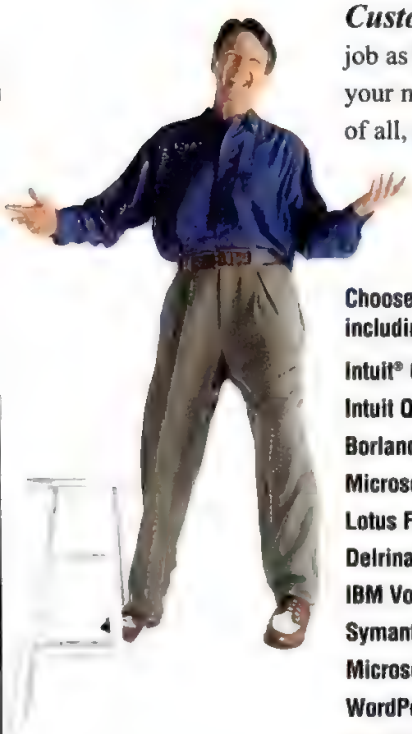

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SUMMARY OF FEATURES

CONTINUES

Products listed in alphabetical order
■ = YES □ = NO

	Initiative Technology ITI 499VL	Int. Instr. Blue Max Business Partner DX4100	Mega Impact 486DX4/100D+	Micron 486DX4 (PCI)	Micron 486DX4 (VLB)	Mitsuba VESA-DX4	NEC Image 4100ES
List price (tested configuration)	$4,495	$3,495	$3,275	$3,199	$2,999	$3,795	$3,837 (estimated)
Hard disk capacity and interface	546MB IDE	545MB IDE	340MB SCSI-2	530MB IDE	530MB IDE	544MB IDE	425MB IDE
Dealers/Direct-distribution channel	■■	■■	■■	■■	■■	■□	■■
Case style	Desktop	Mini-tower	Mini-tower	Desktop	Desktop	Small-footprint	Desktop/Mini-tower
Power supply (and number of connectors)	200W (4)	250W (9)	250W (5)	145W (5)	145W (5)	200W (6)	145W (4)
DOS, Microsoft Windows version	DOS 6.2, Windows for Workgroups 3.11	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.21, Windows for Workgroups 3.11	DOS 6.21, Windows for Workgroups 3.11	DOS 6.2, Windows for Workgroups 3.11	DOS 6.2, Windows 3.1
Warranty	1 year	1 year	1 year	1 year	1 year	2 years	3 years
On-site service charge	N/A	Included (1 year)	N/A	Included (1year)	Included (1year)	$49.00 (1 year)	Included (3 years)
Processor and Memory							
Bus architecture (primary, secondary)	ISA, VL-Bus	ISA, VL-Bus	ISA, VL-Bus	ISA, PCI	ISA, VL-Bus	ISA, VL-Bus	ISA, VL-Bus
Motherboard manufacturer	Micronics	International Instrumentation	KeyTech	Micronics	Micronics	Mitsuba	NEC
Chip set manufacturer	Micronics	SIS	SIS	Intel	Micronics	SIS	Chips & Technologies
Processor upgrade path	ZIF	ZIF	ZIF	ZIF	ZIF	ZIF	ZIF
BIOS version (or date)	Phoenix 0.10 JX30GC-P01	AMI (8/8/93)	AMI (11/11/92)	Phoenix 1.03 M4P-01	Phoenix 0.10 JX30GC P01	AMI (6/6/92)	Phoenix 1.01
Flash memory/16550 UART support	■■	■■	■□	■■	■■	■□	■■
Installable system RAM	4MB–64MB	1MB–128MB	4MB–64MB	8MB–128MB	4MB–64MB	4MB–128MB	4MB–128MB
External RAM cache	128K–256K	64K–512K	128K–1MB	256K	256K	128K–256K	0–256K
Cache architecture	Direct-mapped	Two-way set-associative	Two-way set-associative	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped
Cache write design	Write-back	Write-through	Write-back	Write-back	Write-back	Write-back	Write-through
Components							
Available hard disk sizes	177MB–1GB	250MB–2.2GB	245MB–3GB	340MB–2GB	340MB–2GB	210MB–1.8GB	210MB–1GB
Disk controller location	Motherboard	VL-Bus card	ISA card	PCI card	Motherboard (VL-Bus)	VL-Bus card	Motherboard (VL-Bus)
Accessible drive bays (5.25", 3.5")	3, 2	3, 4	2, 2	3, 0	3, 0	3, 2	2, 1
Internal drive bays (5.25", 3.5")	0, 1	0, 3	0, 1	0, 2	0, 2	0, 0	0, 1
Floppy disk drives	Dual 1.2MB/1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.2MB, 1.44MB	1.44MB
CD-ROM drive	NEC MultiSpin 3Xi	Toshiba 3401B	Sony CDU33A-01	Mitsumi CRMC-FX001D	Mitsumi CRMC-FX001D	Toshiba 4101	NEC MultiSpin 3Xi
ISA, EISA, MCA slots	5, 0, 0	5, 0, 0	5, 0, 0	6, 0, 0	5, 0, 0	6, 0, 0	2, 0, 0
VL-Bus, PCI, proprietary local-bus slots	2, 0, 0	3, 0, 0	2, 0, 0	0, 3, 0	2, 0, 0	2, 0, 0	2, 0, 0
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 0	1, 2, 1
Display circuitry location	VL-Bus card	VL-Bus card	VL-Bus card	PCI card	VL-Bus card	VL-Bus card	Motherboard
Video chip set manufacturer	Weitek	Tseng Laboratories	Weitek	Matrox	Matrox	Tseng Laboratories	Tseng Laboratories
Video RAM	2MB	2MB	2MB	2MB	2MB	2MB	1MB

N/A—Not applicable. The product does not have this feature.
ALR—Advanced Logic Research Inc. ATI—ATI Technologies Inc. EPS—EPS Technologies Inc. HP—Hewlett-Packard Co. IMS—Integrated Micro Solutions. SIS—Silicon Integrated Systems Corp. VLSI—VLSI Technology Inc.

International Instrumentation Inc.

• Blue Max Business Partner DX4100

International Instrumentation has produced an Energy Star–compliant computer that's also a great performer with some room for growth. Priced at $3,495, it's a good value. There is one caveat however: Poor interior design makes it more difficult to take advantage of all available expansion options.

The Blue Max BP DX4100 comes in a mini-tower case with six of its nine drive bays free. That leaves plenty of room to install additional devices, but the slots are more problematic. Of the five ISA and three VL-Bus slots, two ISA slots are filled with 8-bit cards (one by the I/O controller, the other by the CD-ROM drive controller). Two of the VL-Bus slots are occupied by the floppy/hard disk controller and the video controller. None of the ISA slots can accept full-length cards because the CPU, with its heat sink and fan, and one of the drive bay cages are in the way.

Only one of four SIMM banks is full for our 16MB unit; system maximum is 128MB of RAM. The system does have 16550 UART support built in, and it came with a low-radiation 15-inch monitor from Samsung. An equivalent PCI-based system is available from International Instrumentation at the same price.

The Blue Max BP DX4100 is a star performer, especially in the DOS arena. It placed among the top five on all of our DOS-based benchmark tests. Helped by its 256K of external cache, the system delivered a third-place score on our processor tests. The pairing of the Conner hard disk with the Promise VL-Bus controller, which also carries the Tseng video chip set, came through under Windows testing as well, where it helped the Blue Max BP DX4100 achieve average scores on the Graphics WinMark, Disk WinMark, and Winstone tests.

International Instrumentation offers a

FACT FILE

Blue Max Business Partner DX4100

List price: $3,495 **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache **Data storage:** Conner 545MB IDE hard disk with 256K cache, Promise Technology DC4030VL VL-Bus disk controller card with 4MB cache, Toshiba 3401B CD-ROM drive. **Display:** Hercules Dynamite VL-Bus video controller card with 2MB DRAM, Samsung 15C 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.2, Windows 3.1. **In short:** The Blue Max had solid all-around performance.

International Instrumentation; 800-543-3475, 805-495-7673; fax, 805-379-0701

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SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Expandability	EXCELLENT

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Mega Computer Corp.

• Mega Impact 486DX4/100D+

Mega Computer Corp.'s Mega Impact 486DX4/100D+ does little to live up to the promise of its moniker, yielding disappointing performance on all our benchmark tests. A poor design may inhibit future upgrades. For $3,275, there are other PCs out there that will give you much more "impact" for your money.

Mounted vertically inside the Mega Impact's mini-tower case is a KeyTech motherboard with the system's CPU and 256K of write-back cache. What you won't find on this motherboard is integrated I/O, since these functions are relegated to an ISA card.

Two of the remaining ISA slots are filled: one by the controller card for the Sony double-speed CD-ROM drive, the other by an Adaptec controller for the 340MB Quantum SCSI-2 hard disk. This leaves two ISA slots open, but since four of the five ISA slots are partially blocked, they can't be used for full-sized expansion cards.

FACT FILE

Mega Impact 486DX4/100D+

List price: $3,275. **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache **Data storage:** Quantum 340MB SCSI-2 hard disk with 32K cache, Adaptec AMA4542C ISA disk controller card with 16K cache, Sony CDU33A-01 CD-ROM drive **Display:** Diamond Viper VLB VL-Bus video controller card with 2MB VRAM, MGC 1506D 15-inch monitor with a 70-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows 3.1. **In short:** While its price is competitive, the Mega Impact delivered poor performance on most tests.

Mega Computer Corp.; 800-338-6628, 619-487-8888, fax, 619-485-1518

461 on reader service card

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	FAIR
Expandability	GOOD

One of the Mega Impact's two VL-Bus slots was occupied by a Diamond Viper VLB video board with 2MB of VRAM. This card, packing the Weitek P9000 chip, was partially responsible for the Mega's only decent score on our tests: its average showing on the Graphics WinMark tests.

The Mega Impact's other test results included two last-place scores (Disk WinMark and DOS disk) and one second-to-last-place score (Winstone). Its scores on the remaining tests—processor, DOS video, and DOSmark—were a bit better but still far below the average for this roundup.

Mega Computer includes a one-year parts-and-labor warranty with the Mega Impact 486DX4/100D+. What it doesn't include is acceptable performance.—*CV*

Micron Computer

• Micron 486DX4 (VLB)

Like Micron Computer's PCI-based entry, the $2,999 Micron 486DX4 (VLB) is one of those rare birds today: It offers a combination of quality components, low price, and good graphics performance. Both systems showed outstanding performance under Windows, mediocre performance under DOS.

The PCI- and VLB-based Micron systems go their own way in terms of the motherboard and hard disk controller they use. While the VLB-based unit uses the Micronics motherboard's integrated VL-Bus hard disk controller, the PCI-based unit uses a card-based controller. But performance was not sacrificed in the Micron 486DX4 (VLB). This unit posted the top Disk WinMark score of the group. A Matrox MGA video card helped the system earn the second-place score on our Graphics WinMark tests, and the unit also posted the number-one Winstone score. On our DOS-based tests, the Micron 486DX4 (VLB) showed two bright spots: Its processor score was in the top ten, and the 530MB Conner hard disk helped push the system into the top five on our DOS disk tests. Not suprisingly, the Matrox-based video subsystem did not help the Micron 486DX4 (VLB) on our DOS video tests, which is reflected in the poor DOSmark score that this unit posted.

The Micron 486DX4 (VLB), like its PCI-based counterpart, stands out in this roundup because of its graphics capabilities. With both systems, Micron shows

FACT FILE

Micron 486DX4 (VLB)

List price: $2,999. **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache **Data storage:** Conner 530MB IDE hard disk with 256K, integrated VL-Bus disk controller, Mitsumi CRMC-FX001D CD-ROM drive **Display:** Matrox MGA-VLB VL-Bus video controller card with 2MB VRAM, MAG DX15F 15-inch monitor with a 76-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.21, Windows for Workgroups 3.11. **In short:** With performance mirroring that of its PCI-based sibling, this VL-Bus Micron unit was the value choice of the two.

Micron Computer Inc., 800-388-6334, 208-465-3434; fax, 208-465-3424.

463 on reader service card

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	AVERAGE
Technical support	ABOVE AVERAGE

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Separate entrance and exit transitions for each object on a slide.	Yes	Not	Not	Not
Timelines for precise control over multimedia events.	Yes	Not	Not	Not
Animated pictographs and charts that grow and tumble, for greater visual impact.	Yes	Not	Not	Not
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SUMMARY OF FEATURES

ENDS

Products listed in alphabetical order ■ = YES □ = NO	Sidus SCI333Dg/VL	Sys Business Series 486DX4/100-Full Tower	Tagram Thunderbolt XL (PC MAGAZINE)	ZEOS Pantera DX4-100 (PC MAGAZINE)
List price (tested configuration)	$3,099	$4,998	$2,699	$2,895
Hard disk capacity and interface	342MB IDE	976MB IDE	540MB IDE	528MB IDE
Dealers/Direct-distribution channel	■■	■■	■■	■■
Case style	Desktop	Tower	Slimline	Desktop
Power supply (and number of connectors)	200W (5)	250W (5)	200W (4)	200W (6)
DOS, Microsoft Windows version	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows for Workgroups 3.11
Warranty	1 year	1 year	2 years	1 year
On-site service charge	Cost varies	N/A	Included (1 year)	$49.00 (1 year)
Processor and Memory				
Bus architecture (primary, secondary)	ISA, VL-Bus	ISA, VL-Bus	ISA, VL-Bus	ISA, PCI
Motherboard manufacturer	Micronics	Giga-Byte Technology	BCM Advanced Research	ZEOS
Chip set manufacturer	Micronics	SIS	OPTi	Intel
Processor upgrade path	ZIF	ZIF	None	ZIF
BIOS version (or date)	Phoenix 0.10 JX30GC P01	Award (2/3/94)	AMI (11/11/92)	Phoenix/Quadtel 4.02
Flash memory/16550 UART support	■■	■■	■■	■■
Installable system RAM	1MB–64MB	1MB–128MB	4MB–128MB	4MB–128MB
External RAM cache	64K–256K	64K–512K	0–512K	0–256K
Cache architecture	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped
Cache write design	Write-back	Write-back	Write-back	Write-back
Components				
Available hard disk sizes	107MB–3GB	251MB–1.6GB	204MB–1.07GB	214MB–2GB
Disk controller location	Motherboard (VL-Bus)	VL-Bus card	Motherboard	Motherboard
Accessible drive bays (5.25", 3.5")	2, 1	4, 1	2, 2	2, 2
Internal drive bays (5.25", 3.5")	1, 2	1, 3	0, 0	1, 1
Floppy disk drives	1.44MB	Dual 1.2MB/1.44MB	1.44MB	1.44MB
CD-ROM drive	Sony CDU-33A	Toshiba XM3401B	Panasonic CR-562-B	Mitsumi CRMC-FX001D
ISA, EISA, MCA slots	5, 0, 0	4, 0, 0	5, 0, 0	5, 0, 0
VL-Bus, PCI, proprietary local-bus slots	2, 0, 0	3, 0, 0	1, 0, 0	0, 3, 0
Parallel, serial, mouse ports	1, 2, 0	1, 2, 0	1, 2, 1	1, 2, 0
Display circuitry location	VL-Bus card	VL-Bus card	Motherboard (VL-Bus)	PCI card
Video chip set manufacturer	ATI	Matrox	Tseng Laboratories	Weitek
Video RAM	2MB	2MB	2MB	2MB

N/A—Not applicable: The product does not have this feature.
ALR—Advanced Logic Research Inc., ATI—ATI Technologies Inc., EPS—EPS Technologies Inc., HP—Hewlett-Packard Co., IMS—Integrated Micro Solutions, SIS—Silicon Integrated Systems Corp., VLSI—VLSI Technology Inc.

that a combination of quality components and good performance can be had at a reasonable price.—*WPF*

Micron Computer Inc.

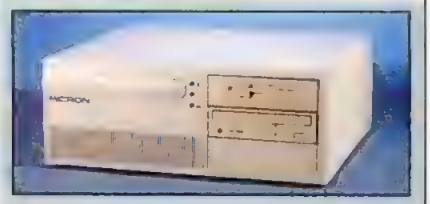
• Micron 486DX4 (PCI)

With pace-setting Windows performance, the $3,199 Micron 486DX4 (PCI), a PCI-based unit from Micron Computer, is an exceptional system for graphics and a good high-end system for the small office or home office.

Although two of this unit's ISA slots cannot accept full-length cards because they are blocked by the memory slots, the motherboard is very neatly designed when compared with some others in this roundup. One interesting design note: The implementation of shared slots has been taken a step further in this unit. Since the shared slot cannot use both ISA and PCI boards at the same time, Micron has opted to install a hard disk controller that uses not only the PCI section of the slot but the end-section of the ISA slot as well.

On our benchmark tests, this unit proved to be a competent performer under DOS and a top performer under Windows. It garnered the highest score on our Graphics WinMark and processor tests and took the second- and third-place scores on our Winstone and Disk WinMark tests, respectively. True to form, this unit's Matrox Ultima video card did not help it on our DOS-based video tests, where the system turned in one of the lowest scores in the group. But the system's 530MB Conner hard disk helped it post scores that were slightly above average on our DOS disk tests.

When considering a PC for a Windows-based environment, it might be hard to find a better system than the Micron 486DX4 (PCI).—*WPF*



FACT FILE

Micron 486DX4 (PCI)

List price: $3,199. **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache. **Data storage:** Conner 530MB IDE hard disk with 256K cache, CMD Technology PCI local-bus disk controller card, Mitsumi CRMC-FX001D CD-ROM drive. **Display:** Matrox Ultima PCI/2 PCI local-bus video controller card with 2MB VRAM, MAG DX15F 15-inch monitor with a 76-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.21, Windows for Workgroups 3.11. **In short:** Stunning performance on our Windows-based benchmark tests and an array of quality components make the Micron 486DX4 (PCI) a good choice.

Micron Computer Inc., 800-388-6334, 208-465-3434; fax, 208-465-3424.

452 on reader service card

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	AVERAGE
Technical support	ABOVE AVERAGE

Mitsuba Corp.

• Mitsuba VESA-DX4

The $3,795 Mitsuba VESA-DX4, though a solid system, falls short of delivering a value product.

This unit comes in a small-footprint desktop case that does leave some room for expansion: Three of six bays are free. There are also eight SIMM banks (expandable to 128MB of RAM), four of which are taken. Of four 16-bit ISA slots, only one is used; it is filled by the floppy disk drive and I/O controller.

There are also two 8-bit ISA slots, both free, and two ISA slots with VL-Bus extensions, both in use (one by the hard disk and CD-ROM drive controller, the other by the video controller). The processor is in a ZIF socket, but its placement blocks the two 8-bit slots and one of the 16-bit slots, so only cards that are shorter than full length will fit.

The Mitsuba VESA-DX4 had trouble on most of our tests. Its Quantum hard disk, paired with an UltraStor 34F VL-Bus hard disk controller card, did not help this system's performance on either our DOS disk tests or our Disk WinMark tests: Both scores were below average.

Mitsuba's DX4-based system placed second to last on our processor tests, despite its 256K external cache, and its DOSmark and Winstone scores were both below average.

The Mitsuba video card—with a Tseng Labs chip set—provided the Mitsuba with its only bright spot, helping the system achieve a very good DOS video score. On our Graphics WinMark tests, however, the Mitsuba VESA's score was below average.

The system is covered by a two-year standard warranty. On-site service for one year costs $49.—*AY*

▶ FACT FILE

Mitsuba VESA-DX4

List price: $3,795 **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache. **Data storage:** Quantum 544MB IDE hard disk with 128K cache, UltraStor 34F VL-Bus disk controller card, Toshiba 4101 CD-ROM drive. **Display:** Mitsuba ZVTW32i VL-Bus video controller card with 2MB VRAM, Mitsuba M710VC 17-inch monitor with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows for Workgroups 3.11. **In short:** Except on our DOS video tests, the Mitsuba unit was a performance laggard, and its price was one of the higher ones in this roundup.

Mitsuba Corp., 800-648-7822, 909-392-2000, fax, 909-392-2021.

464 on reader service card

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	GOOD

NEC Technologies Inc.

• NEC Image 4100ES

The NEC Image 4100ES is a good system with reasonable performance, but at $3,837 it is slightly overpriced.

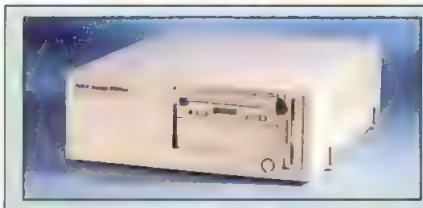
The NEC Image is housed in NEC's "Transformer" case, which can be used as a desktop or mini-tower depending on the placement of its feet. The unit uses a proprietary local-bus card to provide its four expansion slots. All of the expansion slots are left open, but one of the two ISA slots (the other two have VL-Bus extensions) is blocked by the nearby processor plus its heat sink and adapter assemblies, leaving only three usable slots.

Evidence of Sidus Systems' experience shows in its well-designed DX4, with its uncluttered interior and clear documentation.

Fortunately, most subsystems—such as the hard disk, CD-ROM drive (a triple-speed NEC unit; the only one in this group), video, and I/O (including a SCSI-2 port) controllers—are integrated on the motherboard. There are also four SIMM banks, two of which were left open on our test system.

The NEC Image posted above-average scores on many of our tests. This unit, which uses a Tseng Labs ET4000 chip set, turned in the first-place score on our DOS video tests. Its Graphics WinMark score was also competitive, which is surprisingly good considering that this roundup includes PCs packing Matrox video cards withWeitek chip sets—a combination that raises the Windows performance standard. On our DOS-based disk tests, the NEC Image was an average performer, but its score on our Disk WinMark tests fell below the average for the group.

NEC Technologies offers its DX4/100-based NEC Image 4100ES with a three-year warranty and three years of on-site service.—*AY*



▶ FACT FILE

NEC Image 4100ES

List price: $3,837 (estimated). **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache. **Data storage:** Western Digital Caviar 425MB IDE hard disk with 128K cache, integrated disk controller, NEC MultiSpin 3Xi CD-ROM drive. **Display:** Integrated video controller with 1MB VRAM, NEC SVGA 14-inch monitor with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows 3.1. **In short:** The NEC unit turned in the top DOS video score of this roundup as well as reasonable Windows video performance.

NEC Technologies Inc., 800-632-4636, 508-264-8000, fax, 800-366-0476.

465 on reader service card

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	AVERAGE
Repair service	BELOW AVERAGE
Technical support	BELOW AVERAGE

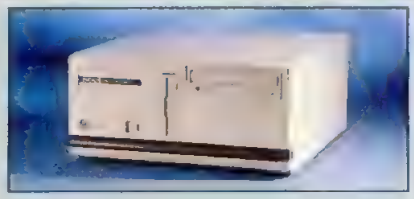
Sidus Systems Inc.

• Sidus SCI933Dg/VL

Although the $3,099 Sidus SCI933Dg/VL is Sidus Systems' first entry in a *PC Magazine* roundup, Sidus is anything but a newcomer to the PC market.

During its 12 years in the PC business, Sidus Systems has become the fourth largest PC manufacturer in Canada, behind Apple, Compaq, and IBM. Recently, Sidus has expanded its business into the United States, and the company feels that this will be its largest area of growth in the near future.

Evidence of the company's experience shows in its well-designed DX4-based system. This unit gets extra points for its uncluttered interior—clearly mapped in the documentation—so you should have no trouble identifying components and specifications for the installed peripherals. Installing additional drives into the three available bays may mean removing the CD-ROM drive, but the slots and upgradable com-



▶ FACT FILE

Sidus SCI933Dg/VL

List price: $3,099 **Processor/memory:** Intel DX4/100, 16MB RAM, 128K external cache **Data storage:** Western Digital 342MB IDE hard disk with 128K cache, integrated disk controller, Sony CDU-33A CD-ROM drive. **Display:** Micronics Computers MVC8000LB-2Mb VL-Bus video controller card with 2MB VRAM, Mitsubishi Electronics Diamond Scan 15FS 15-inch monitor with a 76-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows 3.11. **In short:** The Sidus unit has solid performance and a good design.

Sidus Systems Inc., 800-856-3667, 415-461-6732 (U.S.), 905-882-1600 (Canada); fax, 415-461-7526 (U.S.), 905-882-2429 (Canada).

466 on reader service card

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	GOOD

ponents are otherwise unobstructed.

Though this unit's DOS disk score was subpar considering the 342MB hard disk, the system's overall DOS-based performance was excellent. On processor tests, this system tied for third place with the International Instrumentation entry, and it fell within the top third in the other two DOS categories. Windows-based tests tell a less exciting story: The Sidus SCI933Dg/VL managed average scores, and its disk performance under Windows was no better than it was under DOS.

The middle-of-the-pack price of $3,099 and solid performance of the Sidus SCI933Dg/VL make this an easy system to recommend.—*Jodi L. Wynblatt*

Sys Technology Inc.

• Sys Business Series 486DX4/100-Full Tower

The Sys Business Series 486DX4/100-Full Tower offers solid performance for the most part, but the $4,998 price (which does include a 17-inch monitor) and several of Sys Technology's design choices might make potential buyers hesitate.

The tower case offers plenty of room for additional devices, with six of nine drive bays open. It's in the area of free slots that the system runs into some trouble. Of three 16-bit ISA slots, one is filled by the I/O controller. The one 8-bit ISA slot is occupied by the CD-ROM controller, and of the three ISA slots with VL-Bus extensions, two are used—one by the Matrox video controller, the other by the multifunction Tekram hard disk and floppy disk drive controller.

Housed in a sturdy slimline case, the Tagram Thunderbolt offers an excellent mix of price, features, and performance.

In addition, the three 16-bit ISA slots are blocked by the CPU, so only shorter cards will fit there. All four SIMM banks are full, so expandability to 128MB of RAM would require that all these chips be replaced.

▶ FACT FILE

Sys Business Series 486DX4/100-Full Tower

List price: $4,998 **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache. **Data storage:** Micropolis 976MB IDE hard disk with 512K cache, Alpha Research/Tekram DC-680C VL-Bus disk controller card with 8MB cache, Toshiba XM3401B CD-ROM drive **Display:** Matrox MGA-VLB/2 VL-Bus video controller card with 2MB VRAM, Sony GDM-17SE1 17-inch monitor with a 75-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows 3.1. **In short:** While Sys Technology's unit provides quality Windows video performance, its video performance under DOS leaves something to be desired.

Sys Technology, 310-493-6888, fax, 310-493-2816

467 on reader service card

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	EXCELLENT
Expandability	GOOD

Performance was this unit's strong suit. Its Matrox card helped it get a third-place score on our Graphics WinMark tests. Above-average processor and Disk WinMark scores also brought the system in ahead of most others on our Winstone test. The one dark spot was DOS video performance, which was well below average—in keeping with the Matrox board's reputation—and brought down the system's DOSmark score to below average despite a number-one DOS disk score.

Sys Technologies delivers in terms of performance, but it is priced well above most of the 100-MHz pack.—*AY*

Tagram System Corp.

EDITORS' CHOICE

Tagram Thunderbolt XL

Priced inexpensively at $2,699 and housed in a sturdy slimline case, the Tagram Thunderbolt XL offers an excellent mix of price, features, and performance.

Though adequate, the Tagram Thunderbolt's expansion potential pales next to its superior performance showing. The unit offers five ISA slots, all originating from a riser off the motherboard. Only one slot is filled—by the CD-ROM controller—leaving four slots available. Of

▶ FACT FILE

Tagram Thunderbolt XL

List price: $2,699 **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache **Data storage:** Maxtor 540MB IDE hard disk with 256K cache, integrated disk controller, Panasonic CR-562-B CD-ROM drive **Display:** Integrated VL-Bus video controller with 2MB DRAM, Optiquest 2000DX 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows 3.1. **In short:** The Tagram Thunderbolt XL is priced aggressively, yet it performed as well as many higher-priced systems, posting the top DOSmark score and scoring high on our Windows-based tests as well

Tagram System Corp., 800-824-7267, 714-258-3222; fax, 714-258-3220.

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SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	EXCELLENT
Expandability	GOOD

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those four slots, however, two are obstructed by a clutter of cables. In our test configuration, a single VL-Bus slot sat unused and unusable; but Tagram does offer upgrade riser cards that utilize PCI or VESA local-bus technology.

On our benchmark tests, the Tagram Thunderbolt captured a top-ten position across the board, garnering its most noteworthy scores under DOS. The unit's Maxtor hard disk helped it take second place on our DOS disk tests, tenth on our Disk WinMark tests. Thanks to an integrated Tseng Labs video chip set with 2MB of DRAM, the Tagram Thunderbolt earned the eighth-best Graphics WinMark score and the third-best DOS video score. Such exemplary performance on the DOS platform allowed this system to turn in the highest DOSmark score of all 26 systems in the roundup. The unit ranked sixth on our Winstone test and fifth on our processor tests.

The ZEOS Pantera is Energy Star–compliant. It has integrated SCSI, PCI slots, and built-in surge suppression.

On the whole, Tagram has combined solid components and sensible design to render an impressive system at an equally impressive price.—*Michele Pepe*

ZEOS International Ltd.

FACT FILE

ZEOS Pantera DX4-100

List price: $2,895. **Processor/memory:** Intel DX4/100, 16MB RAM, 256K external cache **Data storage:** Seagate 528MB IDE hard disk with 256K cache, integrated disk controller, Mitsumi CRMC-FX0011D CD-ROM drive. **Display:** Diamond Viper/PCI PCI local-bus video controller card with 2MB VRAM, ZEOS 14-inch monitor with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Windows for Workgroups 3.11, and one Lotus app: 1-2-3 for Windows, Ami Pro, Freelance Graphics, Approach, Improv. **In short:** The ZEOS offers top performance at a good price.

ZEOS International Ltd., 800-554-7172, 612-362-1234; fax, 800-362-1205.

469 on reader service card

SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	GOOD
Expandability	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

EDITORS' CHOICE

ZEOS Pantera DX4-100

The $2,895 ZEOS Pantera DX4-100 offers good performance across the board for one of the lower prices in this roundup, but expansion room could be a little tight.

The ZEOS system is Energy Star–compliant and has a few other perks, such as an integrated SCSI controller, Pentium OverDrive upgradability, and a built-in surge suppressor. This unit also has integrated controllers for the hard disk, floppy disk, and I/O ports, so only one of the unit's PCI slots is filled—by the Diamond Viper VLB video controller card. Though that leaves the five ISA slots free and two of three PCI slots open as well, you may still have a problem. The CPU, with its heat sink and mounted fan, and the nearby external cache slot, may interfere with the placement of full-length cards in four of the five ISA slots. Also, the four full SIMM banks are awkwardly placed and are partially blocked by a drive-cage arm. The system does have four free drive bays, however, which isn't bad for a desktop case.

The ZEOS Pantera DX4-100 turned in the second-highest processor and Disk WinMark scores, and its performance on the remainder of our tests was slightly above average. The only exception was on our DOS video tests, where the ZEOS system, with its Weitek-based Diamond Viper card, turned in a below-average score. But such performance under DOS is typical of video subsystems using the Weitek chip, which is best known as a Windows performer.

In sum, ZEOS has produced an impressive system that seems to have resolved most of the conflicts between price and performance.—*AY* □

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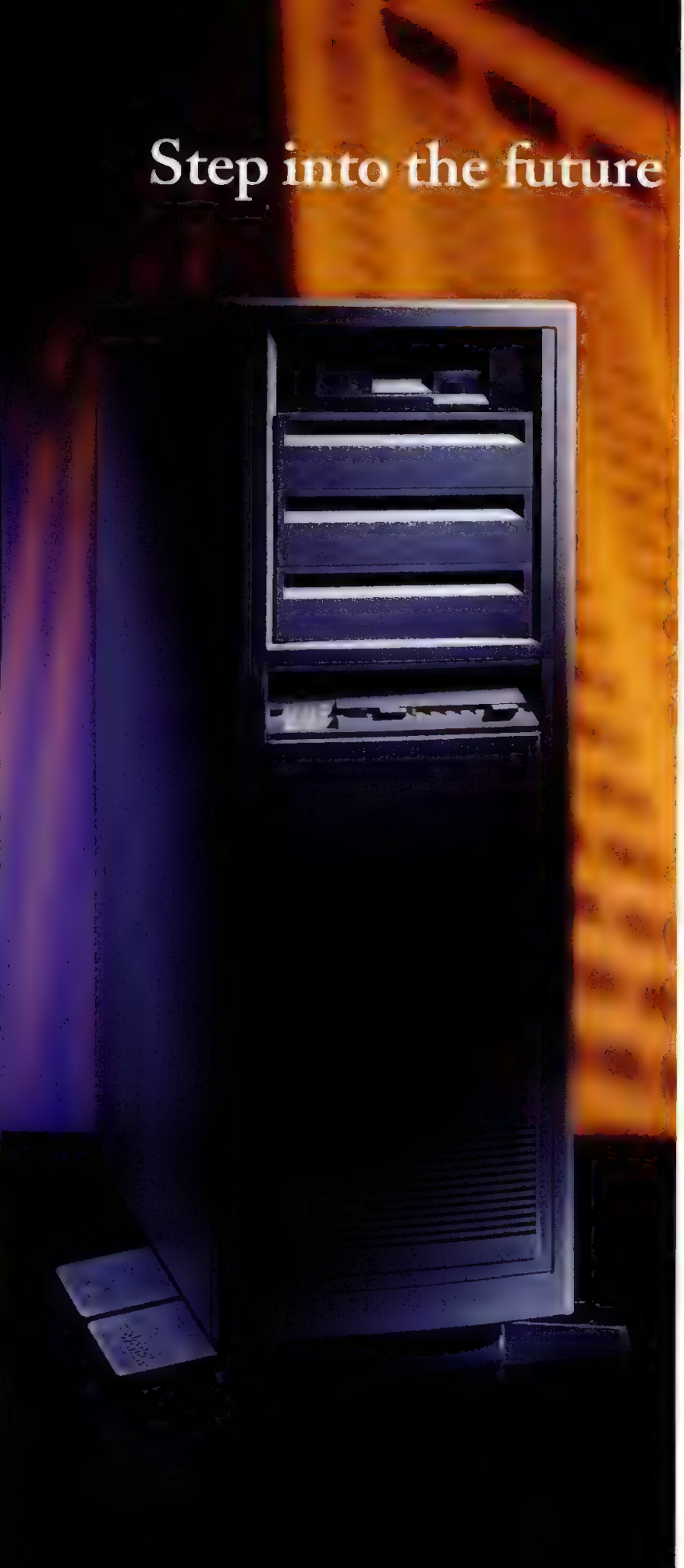

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CIRCLE 090 ON READER SERVICE CARD

90-MHz PENTIUM PCS

Ready to step up to the top-performing PCs available? *PC Magazine* looks at the first six Pentium/90 desktops and the first Pentium/90 server to hit the market.

The Pinnacle *of* Power

Today's hottest PC processor is also one of the coolest. With the introduction of a new line of high-powered Pentium processors, Intel Corp. has managed not only to raise the PC performance bar to new heights, but also to address many of the key criticisms aimed at the first generation of Pentium PCs. The new 90-MHz Pentium CPU—previously known to the computer cognoscenti by its code name, P54C—is available now and is already causing a ripple effect in the price of high-performance PCs.

By the time you read this, the 90-MHz Pentium will have already been surpassed at the high end by its slightly faster 100-MHz cousin, and there will likely be $2,500 Pentium/60 PCs available at the midrange. Prices of the six 90-MHz Pentium PCs in this roundup range from $3,495 to $7,237.

And already prices of systems with less computing power are

IN THIS REVIEW

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By Robert S. Anthony

Photograph by Amy Guip

dropping: By fall, expect entry-level 486DX2/66 PCs to sell for about $1,500, midrange DX4/100s for about $2,500, and high-end Pentiums for about $3,000.

IN THIS ROUNDUP

For this roundup of the most powerful desktop PCs available, we asked for 90-MHz Pentium PCs with a minimum of 16MB of RAM, a 300MB hard disk, an SVGA graphics system with a 15-inch monitor, a 1.44MB floppy disk drive, and a CD-ROM drive. We also requested that DOS 6.0 and Microsoft Windows 3.1 (or newer versions of these programs) be installed. We received and reviewed two machines from Dell Computer Corp. (the Dell Dimension XPS P90 and Dell OmniPlex 590), as well as single entries from Ambra Computer Corp., Hewlett-Packard Co., Micron Computer, and ZEOS International. The reviews are arranged alphabetically; see the preceding article on DX4/100s ("The Value Performer") for explanations of our Suitability to Task rating scheme, Summary of Features table, and test methodology.

Two systems that were introduced too late to test are instructive. With a $3,995 base price, the Gateway 2000 P590 emphasizes value, and it includes a 17-inch monitor and a 540MB hard disk. At the other extreme is the more expensive Compaq Deskpro XL series, which replaces the venerable Compaq Deskpro/M series but as yet goes no higher on the processor ladder than a 66-MHz Pentium processor; Deskpro XL units powered by 90-MHz Pentiums will be available by late summer, however. The Deskpro XL series will offer integrated SCSI, Ethernet networking, audio, and even a microphone and speakers built into the keyboard. The Gateway system should stake claim to the high-performance value buyer, while the Deskpro XL will be aimed at the user who needs every ounce of CPU power and doesn't mind paying for it.

Critics of first-generation Pentium PCs have been spotted rubbing their hands together vigorously over Pentium motherboards.

The common element of the tested units was unparalleled performance. To no one's surprise, the units' Winstone scores topped those of the 60- and 66-MHz Pentium machines we reviewed a scant two and a half months ago by about 30 percent. This is the first group to have members that surpass the Winstone 100 mark, making them roughly ten times as powerful as the 386DX/25 systems that served as our Winstone baseline. Some highlights include the following:

• The HP Vectra XU 5/90C combines superior integration and built-in features

HIGHLIGHTS

90-MHz Pentium PCs

YOU'LL GET COOL POWER out of these new chips. The six units we tested showed that this Pentium generation solves the heat problems of the older generation with a cooler, less power-hungry design. The Pentium/90 should consume 3 to 4 watts of power under normal operation, compared with as much as 16 watts for the Pentium/66.

THERE'S A SLIDING PRICE SCALE in effect because of the new chip on the block. Prices of older 60- and 66-MHz Pentium units are already falling, and ripples are being felt all the way down the CPU chain. Consumers can expect to find 486DX2/66 systems starting at $1,500 and Pentium PCs at $2,500.

INTEL IS GUARDING GROUND by releasing the 90-MHz processor early. The move has kept its competitors scrambling to play catch-up with home-grown technology—for the time being.

YOU'RE OUT OF LUCK ON UPGRADES, since the new 90-MHz CPU is not pin-compatible with older Pentium processors—yet. Advanced Micro Devices, Cyrix Corp., and Intel Corp. are still working on it.

PENTIUM NOTEBOOKS on the horizon? The low-voltage, low-heat design of Pentium's newest generation removes most of the impediments to taking Pentium on the road, and the new CPU also includes some new power management features.

PCI WON A COUP in this roundup. VL-Buses were completely absent; all six of the tested units used the PCI bus.

PENTIUM/90s RAISE THE mark by leaving the old *PC Magazine* benchmark test records in the dust and setting new highs on all of our tests.

PITFALLS have cropped up in adapting the new chips. Many vendors in this roundup used voltage regulators between the chips and the motherboard, and ended up making some expansion slots unavailable for full-length cards.

WHAT WE ASKED FOR: A 90-MHz Pentium PC with 16MB of RAM, a 300MB hard disk, SVGA graphics, a 15-inch monitor, CD-ROM and floppy drives, and DOS 6.0 and Microsoft Windows 3.1.

WHAT WE GOT: Two Dell units, and single units from Ambra Computer Corp., Hewlett-Packard Co., Micron Computer, and ZEOS International. We also received one Pentium/90 server from HP (see the sidebar "HP's First Pentium/90 Server").

with high-end performance. It was at or near the top on all of our Windows-based benchmark tests and set a new record on our processor tests.

• The Micron P90PCI's score of 108.3 on our Winstone test easily surpassed the 88.1 logged by the 66-MHz Pentium-based Dell OmniPlex 566 (profiled in our April 12 roundup). The Micron P90PCI scored well ahead of the test pack on our Disk WinMark test and topped the list on our DOS-based disk tests as well.

• The Dell Dimension XPS P90 set a record with a DOS video score of 7,596, easily surpassing the 4,549 set by the 60-MHz Duracom DeskSaver Pentium-PCI (also profiled in our April 12 issue).

• The HP NetServer 5/90 LM is the first server to use this powerful CPU. Its test results placed it roughly between servers configured with a single Pentium/66 and those configured with two Pentium/66s. For more information on the HP NetServer, see the sidebar "HP's First Pentium/90 Server."

PC MAGAZINE EDITORS' CHOICE

- *Performance choice:* ..... **HP Vectra XU 5/90C**
- *Value choice:* ..... **Micron P90PCI**

When you are reaching for the utmost in computing power, price is usually a distant second consideration after performance. While last year's buyers of the first Pentium/60 PCs had little choice—the entrance price was about $8,000—today's buyers of Pentium/90 PCs can choose from two alternatives: inexpensive and basic, or expensive and fully loaded. In this roundup, the value choices are the Ambra DP90 PCI, Dell Dimension XPS P90, Micron P90PCI, and ZEOS Pantera 90, all of which are available for less than $4,500. The Dell OmniPlex 590 and HP Vectra XU 5/90C are priced closer to $7,000, but they include many extra features.

PRICE VS. POWER

Offering the most advanced PC design we've seen, the HP Vectra XU is a power user's dream that includes an integrated SCSI-2 interface, Ethernet and Token-Ring networking circuitry on-board, and a high-quality 16-inch monitor. If value is paramount, the Micron P90PCI is more of a standard configuration and offers all you'll need for higher-order computing.

While these PCI-based 90-MHz Pentium PCs were generally tightly grouped in performance, the HP Vectra XU and Micron P90PCI traded between first and second place on most of our Windows-based benchmark tests. The downside of both units is their merely adequate (not stellar) DOS performance.

DUAL-PROCESSING FUTURE

When you look inside the HP Vectra XU's case, you see how advanced this system is. The empty Level 5 CPU socket on the motherboard can accept Intel's P54C/M add-on CPU, which will allow dual processing when the parts become available later this year. Adding a second processor won't double processing power, but it will raise desktop computing to the realm of RISC workstations. On the other hand, this dual-processor complex requires the use of an operating system—such as OS/2, Unix, or Microsoft Windows NT—that can take advantage of symmetric multiprocessing. With the ability to carry a second Pentium, the HP Vectra XU is not only miles ahead of the competition; it's a PC designed today for tomorrow.

COOLING DOWN

It used to be you could tell that a PC had an Intel Pentium inside just by listening; it was the machine with the sound of extra fans buzzing inside. Critics of first-generation Pentium PCs have been spotted rubbing their hands together vigorously over Pentium motherboards, as if the heat generated by the CPU were equivalent to that of a space heater.

With the introduction of the new 3.3-volt Pentium/90, Intel has managed to cool down the inside of powerful PCs. First-generation Pentiums drew up to 16 watts at 5 volts, were based on an 0.8-micron design, and ran hot to the touch. The Pentium/90, however, draws just 3 to 4 watts at 3.3 volts, uses a smaller 0.6-micron design, and operates at a far cooler temperature than the old Pentiums.

While internal heat control is still critical in a Pentium PC, vendors no longer have to resort to massive heat sinks, carefully controlled air-flow patterns, liquid-based cooling schemes, or other elaborate measures to design reliable systems. The smaller die size of the 90-MHz Pentium has two major benefits: The chip is less expensive to make and the new process allows for much higher clock speeds. In fact, speeds of 90 MHz and 100 MHz are just the beginning for this chip. Expect to see 132- and 150-MHz versions down the road.

The debut of the 90-MHz Pentium came as competitors such as Advanced Micro Devices and Cyrix Corp. were still working on CPUs to challenge the 66-MHz Pentium. By raising the performance ceiling for *x*86-compatible chips, Intel has—at least temporarily—put its competition on the ropes.

The debut of the first machines using the PowerPC chip architecture designed by Apple Computer, IBM Corp., and Motorola helped to speed the arrival of the 90-MHz Pentium chips. But the utter scarcity of mainstream applications native to the PowerPC platform and the huge installed base of IBM-compatible PCs guarantee the Pentium a level of protection even if the raw performance of the PowerPC design eventually surpasses the Pentium's capabilities by a wide margin.

This roundup represents a watershed in that the Peripheral Component Interconnect (PCI) local-bus standard scored a 6-0 shutout against the rival VL-Bus standard. All six of the tested machines use PCI cards or integrated PCI-bus design for their video subsystems. This shift to PCI contrasts sharply with what we found in our last Pentium roundup, in which nearly a third of the 31 60- and 66-MHz machines

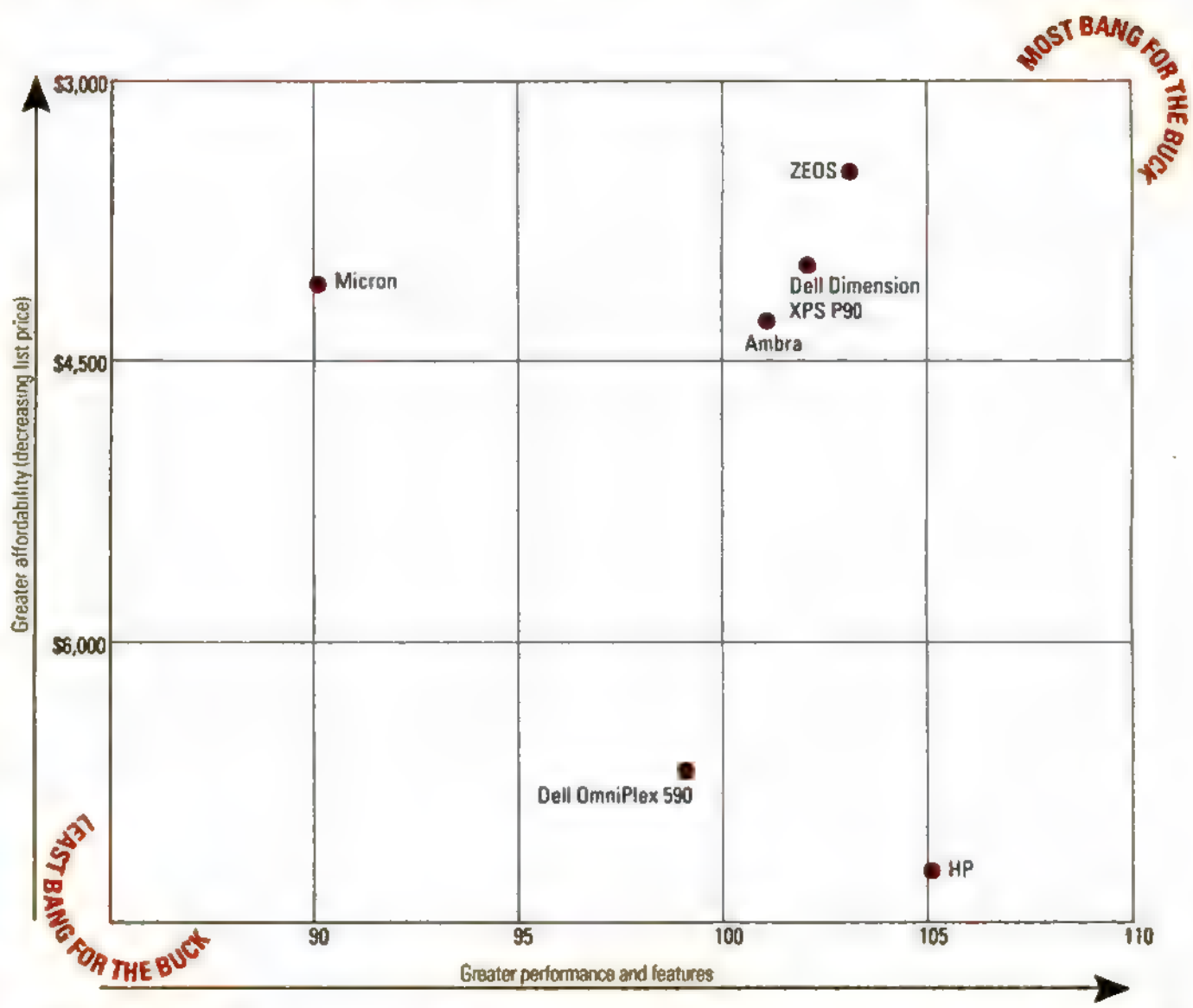
Price/Performance Index: *90-MHz Pentium PCs*

This is a small field, and the participants were within 15 points of each other on the performance/features side of the equation. Prices for these six machines varied a bit more, ranging from $3,495 to $7,237.

The price/performance leader in this roundup, the ZEOS Pantera 90, is a massive tower system with nearly unlimited expansion room and competitive performance under both DOS and Windows. It is also the lowest-priced machine here.

The runner-up, the Dell Dimension XPS P90, is notable for its thoughtful interior design, which is obstruction-free. Many of the machines that we've seen recently suffer from expansion-card slots that are blocked by poorly placed memory slots or heat sinks.

The HP Vectra XU 5/90C was the most expensive, costing more than twice as much as the ZEOS Pantera 90. It performed outstandingly under Windows, though, and features an innovative motherboard design capable of supporting multiprocessing. The Micron P90PCI does as well under Windows as the HP Vectra XU, and does so for $4,099. If your computing style leans heavily on Windows, this is a good value choice.



THE DATA POINTS

In calculating the performance/features scores of these 90-MHz Pentium systems, we gave Winstone and DOSmark scores the most weight. We also looked at the warranty, on-site service charge, and expansion capabilities. The combined benchmark test scores account for 65 percent of each score; all else accounts for the remaining 35 percent. For more information, look in the Software Library of the Editorial Forum on PC MagNet under 12BANG .XLS.

used VL-Bus architecture. Part of this shift may be due to the availability of new and improved PCI-support chip sets from Intel and other chip makers.

Unlike the first Pentium units, which were slow in getting to PC vendors and even slower in getting to consumers, Pentium/90 PCs are readily available in volume. The first Pentium/90 PCs were available within weeks after the chip's announcement in March.

The move by PC manufacturers to the 3.3-volt Pentium chip was not without a few stumbling blocks, and we found evidence of a few of them during testing. Some vendors, like ZEOS, installed the new 3.3-volt Pentium chip onto a 5-volt Pentium motherboard by using a voltage-converting circuit card between the CPU and its socket. While this design may not affect performance, the sandwiched components were often high and wide enough to interfere with long expansion boards. Such interim designs will change, of course, as more 3.3-volt and switchable 3.3- and 5-volt Pentium motherboards become available.

As the 90-MHz Pentium (and, soon enough, the 100-MHz version) takes over at the top of processor-performance charts, prices of 60- and 66-MHz Pentium PCs are beginning to drop. Speeding the price drop are aggressively priced PCs built around Intel's new DX4 line of clock-tripled 486 chips and the promise of powerful new chips from AMD and Cyrix.

PENTIUM PORTABLES

If you're drooling over the potential of having a 90-MHz Pentium PC on your desktop, just think of the fun you'll have with such a powerful PC on the road. The low-voltage, low-heat design of the chip removes most of the impediments that have stood in the way of putting a Pentium in a notebook, and there will soon be a 75-MHz processor that meets the needs of mobile power users. Also, all variations of the Pentium/90 offer advanced power management functions, such as the ability to turn off the floating-point unit when it is not needed.

If you're looking to upgrade your current Pentium machine with one of these new 90-MHz chips, you're out of luck. Aside from the voltage difference, the 90-MHz Pentium has a different pin layout than older Pentiums, making a chip swap impossible. Upgrade options for 5-volt Pentium PC owners are forthcoming from AMD, Cyrix, and Intel, however.

With the availability later this year of the dual-processing P54C/M CPU complex, desktop systems will rise to the level of RISC workstations in raw computing power. The HP Vectra XU is the first system we've seen that can take advantage of dual processing by using its empty Level 5 socket. Of course, if you intend to use symmetric multiprocessing, plan on using an operating system that can take advantage of that second processor.

Whether you need power computing on the road or on your desk, the 90-MHz Pentium is today's chip of choice.

Ambra Computer Corp.

Ambra DP90 PCI

With the Ambra DP90 PCI, Ambra Computer Corp.—an independent subsidiary of IBM Corp.—has developed a machine that offers excellent performance at a reasonable price ($4,299). The Ambra DP90 PCI is a fully configured, portable power system.

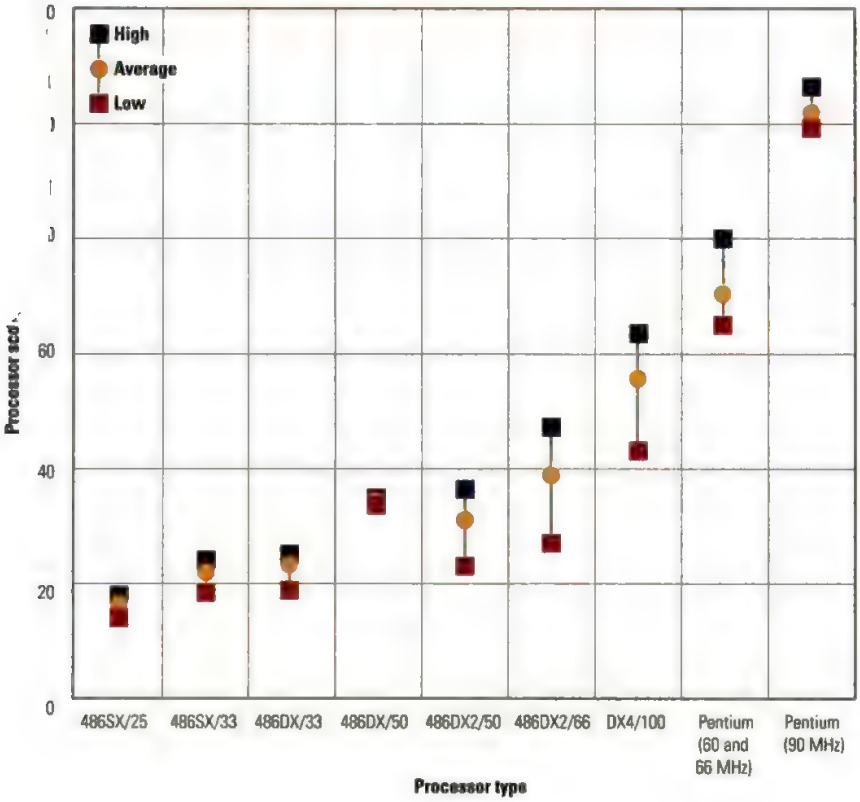
The standard desktop case holds six drive bays and a 200-watt power supply. The motherboard incorporates three PCI slots, one of which shares real estate with one of the unit's five ISA slots.

Unfortunately, the Ambra DP90 PCI has the same design shortcoming that we saw in many of the systems in this issue: Two of the ISA slots cannot facilitate full-size expansion cards because of the position of the memory sockets. If the sockets are in use, full-length cards will not fit. In addition, one of the four memory sockets is inaccessible unless you remove the drive bay casing above it. This is done relatively easily by removing two screws, however, and shouldn't really be a problem for the type of user who would purchase this class of machine. The company rounds out this high-end configuration with a Media Vision sound card and a 17-inch monitor.

Ambra is able to offer competent performance in a solidly built system that has all of today's necessary trappings built in.

Although this unit's processor score was the lowest in the group (all of the processor scores in this roundup were very close, however, and this system's score was only 7 percent behind that of the group leader, the HP Vectra XU 5/90C), its overall performance was respectable. Its 528-MB Western Digital hard disk helped it post an above-average score on our DOS disk tests. Its DOS-based video results were respectable and only ranked below average because of the Dell Dimension XPS P90's astronomical score. Its DOSmark score was average, and its Weitek Power 9000 chip set allowed it to achieve an average Graphics WinMark score. The Ambra DP90 PCI's Disk WinMark score was below average, but its Winstone score was competitive with the scores garnered

How the New Pentium Fits In



▶ FACT FILE

Ambra DP90 PCI

List price: $4,299. **Processor/memory:** Pentium/90, 16MB RAM, 256K external cache **Data storage:** Western Digital 528MB IDE hard disk with 128K cache, integrated disk controller, Philips CM 206 CD-ROM drive (with Media Vision Pro Audio 16 sound card) **Display:** Diamond Viper PCI local-bus video controller card with 2MB VRAM, Ambra 17-inch monitor with a 72-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Microsoft Windows 3.1 **In short:** The Ambra DP90 PCI offers a good balance between performance and price. The unit turned in respectable scores on both our DOS- and Windows-based benchmark tests. While it lacks high-end features, such as a network interface, this unit is clearly a good starter system with reasonable room for expansion.

Ambra Computer Corp.; 800-252-6272, 919-713-1550

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SUITABILITY TO TASK	
DOS applications	GOOD
Windows applications	EXCELLENT
Expandability	GOOD

Benchmark Tests: 90-MHz Pentium PCs

The current speed demons of the PC world, Pentium/90 systems broke existing records on all of our benchmark tests. The best can outperform a 25-MHz 386-based PC tenfold on Windows applications.

What the Numbers Mean

WINSTONE 94

Finishing in a virtual tie were the Micron P90PCI and HP Vectra XU 5/90C, with Winstone scores of 108.3 and 107.9, respectively. These scores—more than 10 percent higher than those of the next-best systems reviewed—are the result of superior components and optimization. In the Micron P90PCI's case, a very fast PCI/IDE disk subsystem and PCI graphics subsystem made the difference. For the HP Vectra XU, it was the use of efficient synchronous SRAM and 512K of external (L2) cache that figured strongly. Their common element is a PCI-based Matrox MGA-II graphics adapter. All of the other systems delivered Winstone scores below 100.

PROCESSOR

The HP Vectra XU posted the highest processor score we've seen to date: 107.0. This is largely because it uses 512K of L2 cache based on very fast synchronous SRAM. The HP Vectra XU and Dell OmniPlex 590 were the only tested units to use this expensive 9-nanosecond synchronous SRAM. The Dell OmniPlex 590 managed a second-place processor score, even though it has only 256K of L2 cache. The Ambra DP90 PCI's last-place processor score of 100.1 was due to its use of slower 20-ns asynchronous SRAM for its 256K of external cache. Showing the immaturity of 90-MHz systems, processor scores varied by only 7 percent between the worst and best.

Given that all of the tested systems carry 90-MHz Pentiums, the major factors affecting processor and memory performance included chip set implementation; L2 cache architecture, size, and write policy; SRAM and DRAM design and speed; and wait states inserted in burst memory cycles. Intel chip sets are present in all of the tested systems. The Ambra DP90 PCI, Dell Dimension XPS P90, HP Vectra XU, and Micron P90PCI all use Intel's new 3.3-volt PCI chip set, called Neptune. Neptune-based PCs provide true 3.3-volt operation for their CPU sock-ets and surrounding chip set logic but work with either 3- or 5-volt current to power DRAM and other system logic. Intel says the Neptune chip set accelerates concurrent read/write opera-tions and buffering, resulting in a performance boost.

We saw no entirely 3.3-volt motherboards in this roundup mainly because 3.3-volt motherboard parts were still in shor supply at test time. Also, under optimal conditions, th Neptune chip set in conjunction with synchronous SRAI external cache takes six clock cycles to transfer 256 bits data. With asynchronous SRAM external cache, it takes nir clock cycles.

The Dell OmniPlex 590 and ZEOS Pantera 90 use Inte older Mercury chip sets with 5-volt motherboard desig These systems require a voltage converter to run the CPU 3.3 volts. The Mercury chip set also allows only a maxim 192MB of system RAM, compared with the Neptune chip s 512MB, and it lacks dual-processor support, which Nept provides.

GRAPHICS WINMARK AND DOS VIDEO

The HP Vectra XU's number-one Graphics WinMark sco 34.4 million pixels per second was attained with the help 64-bit Matrox MGA-II graphics adapter. The Micron P9 which also uses the Matrox board, posted the second Graphics WinMark score. Number Nine Computer C new 64-bit GXE-64 board propelled the Dell Dimensic to third place, and both the Ambra DP90 PCI and Pantera 90 performed similarly using Weitek P9000–equ Diamond Viper boards.

Systems using Tseng Laboratories chip sets have tra ally been the fastest DOS video performers, but th Dimension P90, equipped with the Number Nine vid troller card, turned in the highest DOS video score we recorded. The Dell Dimension P90 posted a score of more than 13 times as fast as that of the Micron P90PCI

DISK WINMARK

The Micron P90PCI, ZEOS Pantera 90, and HP Vect were the top three Disk WinMark performers, and all Microsoft Windows for Workgroups 3.11, which supports 32-bit file access. (The Micron P90PCI's score of 3,060 was again the highest recorded to date.) The rest of the vendors shipped by the majority of the systems in the group.

Ambra is able to offer competent performance in a solidly built system that has all of today's necessary trappings, including PCI local bus, a video accelerator, a sound board, and CD-ROM. This is a perfect blue-collar system designed for the high-end desktop user who doesn't need any extra amenities like integrated SCSI or networking capabilities.—*William P. Flanagan*

Dell Computer Corp.

• Dell Dimension XPS P90

Despite the fact that it is being marketed as a system for the masses, Dell Computer Corp.'s Dell Dimension XPS P90 ($3,999) has the makings of a high-performance PC. Not only was its performance on our benchmark tests squarely in the middle of the pack, but its design shows that Dell has made the most out of the usually limited space of desktop systems.

The attention to detail in this system is impeccable. The motherboard is neatly laid out with nothing obstructing access to any of its components. Even the wire running from the sound card to the CD-ROM is routed so as not to cross the motherboard. While this might seem a minor consideration, it is an indication of a higher level of care and thought that is absent in so many PCs today.

CONTINUES

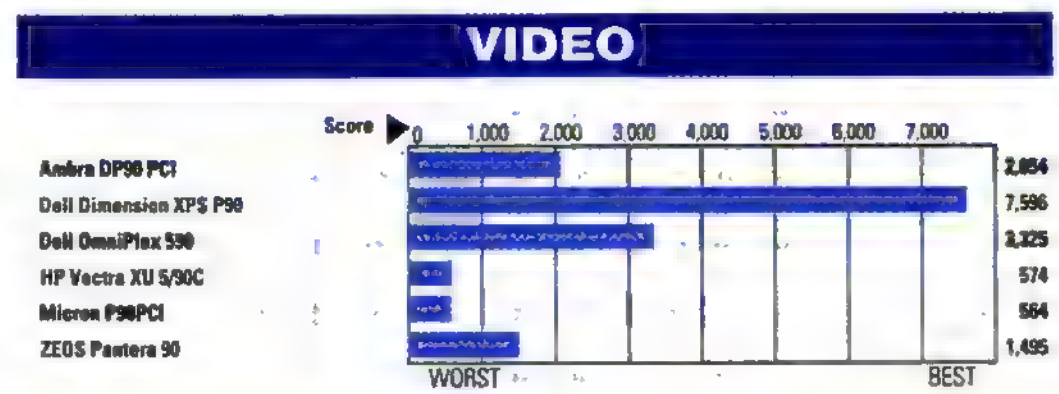
their systems with Windows 3.1 installed; these products delivered Disk WinMark results that fell between 45 and 50 percent lower than the Micron P90PCI's score.

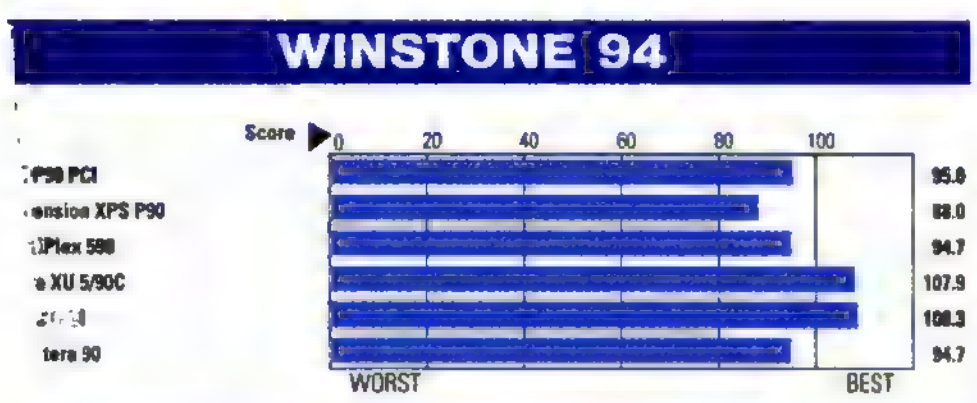
DOS DISK

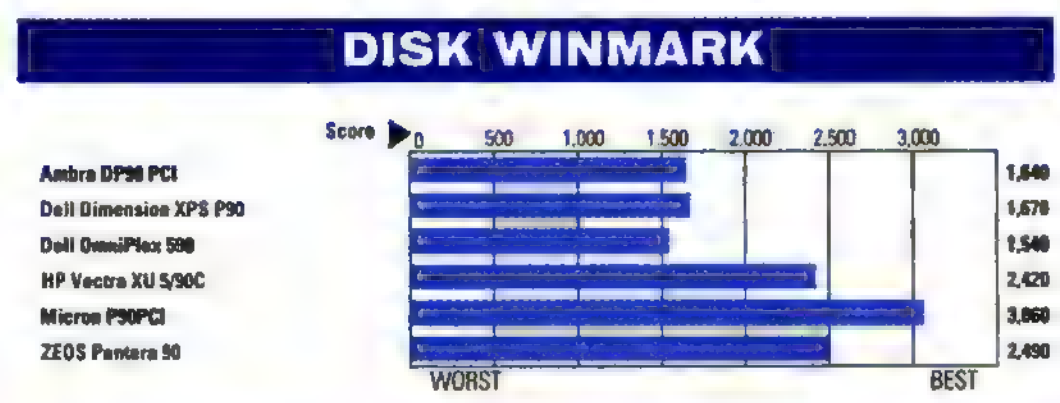
Equipped with a 32-bit PCI Enhanced IDE Mode-3 interface—which provides for a maximum throughput of 11MB per second in burst transfer mode—and a 540MB Conner CFA540A Enhanced IDE hard disk with 512K of on-board cache, the Micron P90PCI's disk subsystem propelled the unit to first place on our DOS disk tests. Assisted by our standard 2MB SmartDrive setup configured in write-back mode, the unit posted a score of 1,852—the best we have seen to date. The Ambra DP90 PCI wasn't too far behind, using a PCI-connected Western Digital Caviar 2540 IDE hard disk.

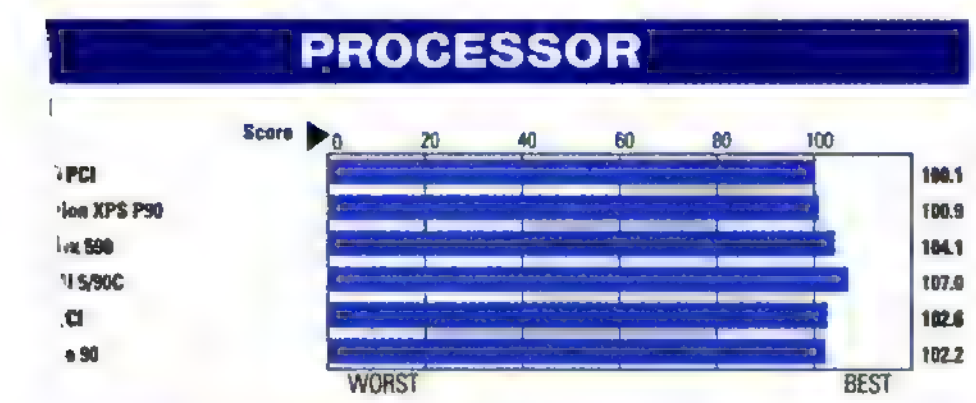
DOSMARK

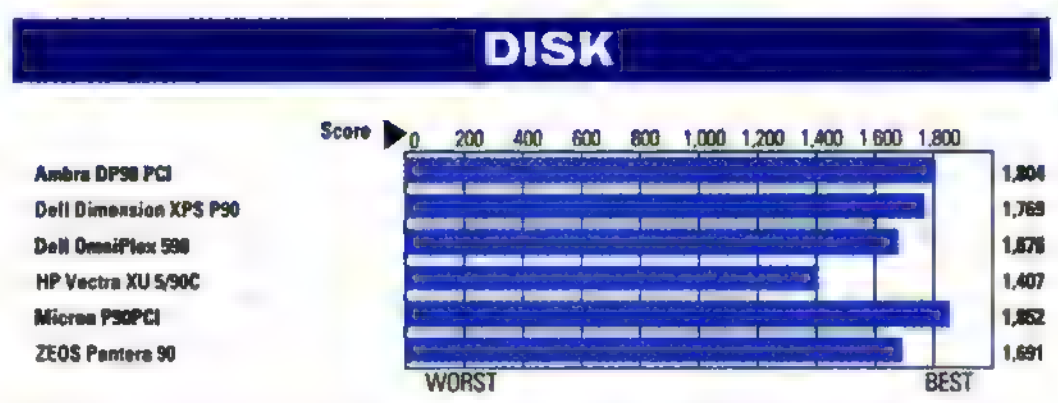
Driven by its outstanding DOS video and disk scores, the Dell Dimension P90 shattered records with a whopping DOSmark score of 1,386. The Dell OmniPlex 590 was nowhere near as fast on our DOS video tests, but it managed a second-place DOSmark score thanks to its strong processor and DOS disk showing.—*Analysis written by Nick Stam*

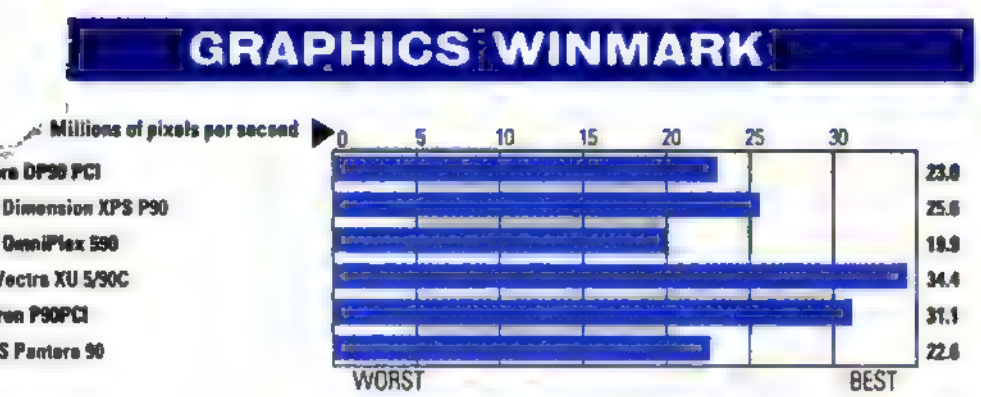


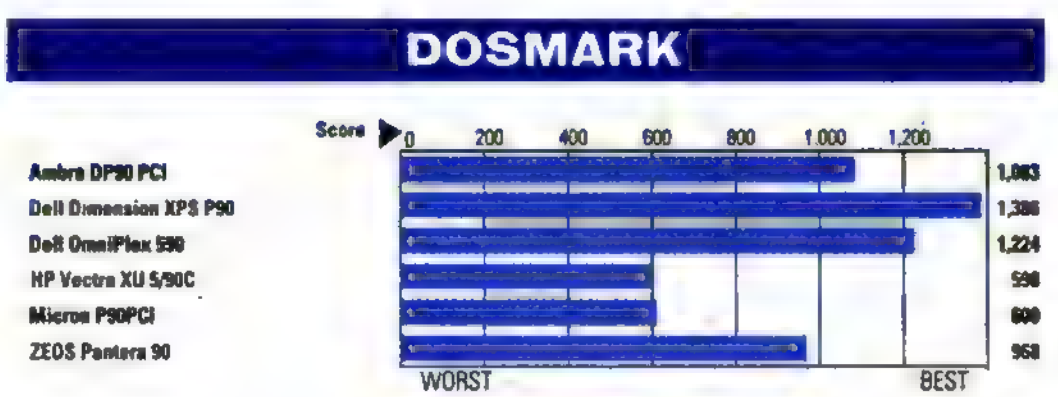












The system's five ISA slots and three PCI slots are integrated onto the board. One PCI slot is taken up by the Number Nine video card that blew the roof off our DOS video tests. One ISA slot is being used by a Sound Blaster 16 card, and one PCI slot shares motherboard real estate with an ISA slot.

In terms of performance, the Dell Dimension P90 is a well balanced system, but it leans more toward DOS rather than Windows applications. Its DOSmark score was the best here, partly thanks to its top DOS video score, which was more than double that of the next-fastest system (the much higher-priced Dell OmniPlex 590). The Dell Dimension P90's DOS disk score was strong, but one would expect better performance from a system with a 1GB Conner drive. Windows performance was average. The Disk WinMark and Graphics WinMark scores were on a par with the scores posted by the majority of the group. The unit's Winstone score was the lowest in this roundup, but the results were closely spaced.

Although the Dell Dimension P90 doesn't offer the versatility or options (such as an integrated SCSI-2 adapter) of its high-end cousin, the Dell OmniPlex 590, it was the better performer overall, and it offers expansion the traditional way—using space instead of technology. The Dell Dimension P90 is extremely well suited to the traditional desktop user interested in building onto the system over time. —*WPF*

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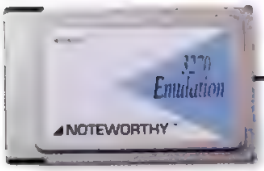
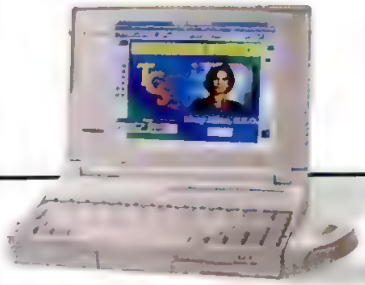


T4800CT



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CIRCLE 379 ON READER SERVICE CARD

▶ FACT FILE

Dell Dimension XPS P90

List price: $3,999. **Processor/memory:** Pentium/90, 16MB RAM, 256K external cache. **Data storage:** 1GB Conner IDE hard disk, integrated disk controller, Panasonic CDR-563 CD-ROM drive. **Display:** Number Nine #9GXE 64 PCI local-bus video controller card with 4MB VRAM, Dell UltraScan 15VS 15-inch monitor with a 72-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.2, Microsoft Windows 3.1. **In short:** Priced aggressively, the Dell Dimension XPS P90 performed well on most of our benchmark tests, even beating its more expensive cousin, the Dell OmniPlex 590, on a few of them. Though it lacks some of the high-end features of the Dell OmniPlex 590—such as a built-in SCSI-2 interface—the Dell Dimension P90 provides enough standard features to satisfy most users.

Dell Computer Corp; 800-289-3355, 512-338-4400; fax, 512-728-3653

472 on reader service card

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

Dell Computer Corp.

• Dell OmniPlex 590

Aside from adding the Pentium/90 CPU, Dell Computer Corp. has not changed the basic design of its high-performance OmniPlex system. And although the competition is tougher at this level, the $6,699 Dell OmniPlex 590 is competitive and posted consistently high marks on our DOS-based benchmark tests.

Again, the design of this EISA/PCI system is much the same as that of the system that won an Editors' Choice award in an earlier Pentium roundup (April 12). An ATI graphics accelerator chip is integrated onto the motherboard, and seven slots are connected to the motherboard via a riser card—two of which are PCI slots that share real estate with two of the EISA slots. Therefore, only five slots can be utilized at any one time. Three out of the system's four drive bays are in use, but a SCSI-2 adapter is integrated onto the riser so expansion is not severely limited.

▶ FACT FILE

Dell OmniPlex 590

List price: $6,699. **Processor/memory:** Pentium/90, 16MB RAM, 256K external cache. **Data storage:** Digital 535MB SCSI-2 hard disk with 512K cache, integrated PCI local-bus disk controller, Toshiba XM-3401TA CD-ROM drive. **Display:** Integrated PCI video controller with 2MB VRAM, Dell UltraScan 15ES 15-inch monitor with a 76-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.2, Microsoft Windows 3.1. **In short:** The Dell OmniPlex 590 posted some of the best scores we saw on our DOS-based benchmark tests but could not keep up with the pack on our Windows-based tests. Motherboard-integrated features like a SCSI-2 interface and an ATI video subsystem make this unit a solid offering.

Dell Computer Corp; 800-289-3355, 512-338-4400; fax, 512-728-3653

473 on reader service card

SUITABILITY TO TASK	
DOS applications	EXCELLENT
Windows applications	GOOD
Expandability	FAIR
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

The Dell OmniPlex 590 proved to be a better performer under DOS than Windows. The unit posted second-place scores on our processor and DOS video tests, and turned in a number-two DOSmark score as well. Its DOS video score, however, while well above the third-place score, was still less than half that of the score posted by the first-place system, the Dell Dimension XPS P90. (This unit also posted the better DOSmark score.) The Dell OmniPlex 590's 535MB Digital hard disk helped it post an average score on our DOS disk tests. On our Disk WinMark tests, the system turned in the lowest score of the group. The motherboard's local-bus PCI architecture and ATI Mach32 chip set contributed to a slightly below-average score on our Graphics WinMark tests. The unit's Winstone score was average, however.

Although the Dell OmniPlex 590 does not blow the doors off the competition, unique design options such as the integrated SCSI-2 controller and shared EISA/PCI slots show Dell's attention to design and make the system particularly well suited to the high-performance PC buyer.—*WPF*

Hewlett-Packard Co.

EDITORS' CHOICE

HP Vectra XU 5/90C

In addition to an outstanding level of performance, the $7,237 HP Vectra XU 5/90C has the most advanced design of any system here. In all respects, it is a winner. To think through a design and come up with a unique plan that covers all the bases is one thing, but to carry out that

▶ FACT FILE

HP Vectra XU 5/90C

List price: $7,237. **Processor/memory:** Pentium/90, 16MB RAM, 512K external cache. **Data storage:** Quantum ProDrive 340MB IDE hard disk with 128K cache, integrated PCI disk controller, Toshiba XM-4101B CD-ROM drive. **Display:** Matrox MGA PCI/2+ PCI local-bus video controller card with 2MB VRAM, HP D2807A 16-inch monitor with a 75-Hz refresh rate at 1,024-by-768. **Software:** DOS 6.2, Microsoft Windows for Workgroups 3.11. **In short:** Its price may scare some buyers away, but the components in the HP Vectra XU 5/90C are some of the best. Its advanced design helped it earn top scores on our Windows-based tests.

Hewlett-Packard Co.; 800-752-0900, 303-635-1000; fax, 208-344-4809

474 on reader service card

SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	EXCELLENT
Expandability	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	ABOVE AVERAGE
Technical support	ABOVE AVERAGE

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CIRCLE 144 ON READER SERVICE CARD

HP's First Pentium/90 Server

By Shawn Kafaipur

Selecting an application server for your mission-critical applications is no easy task, what with the wide range of CPUs and multiprocessing configurations available today. The ideal application server must be an information workhorse that is reliable, scalable, and expandable, yet moderately priced. The HP NetServer LM line, from Hewlett-Packard Co., meets those requirements, and its new Pentium/90 configuration offers businesses even more functionality.

The HP NetServer 5/90 LM, based on the Intel Xpress architecture, doesn't skimp on expandability. The midheight tower case contains eight drive bays (six of which are available for use), eight EISA bus-mastering slots, and a 386-watt power supply with no fewer than seven connectors. The unit can be configured with up to 384MB of memory.

The HP NetServer that we tested can support either the 3.3-volt Pentium/90 or the older 5-volt Pentium chips. As yet, only the 60- and 66-MHz Pentium systems support symmetric multiprocessing. Our test machine was configured with 128MB of RAM, four 1GB Fast SCSI-2 hard disks, HP's SCSI disk array controller with 4MB of cache, 256K of external cache per processor, and four NE3200 Ethernet boards. To see how the Pentium/90 stacked up, we tested the Pentium/90 configuration against Pentium/60, Pentium/66, and dual-Pentium/66 configurations.

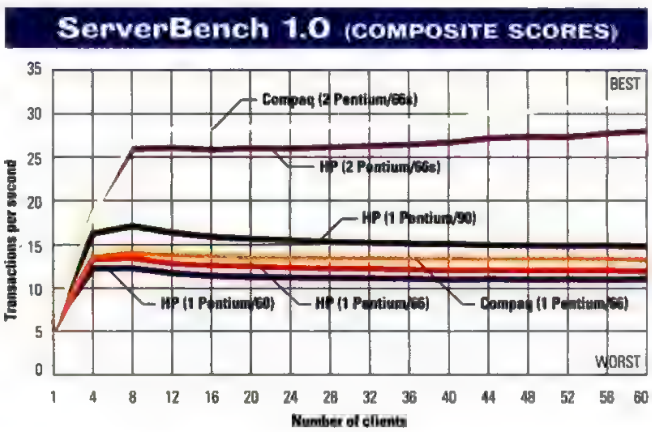
COMPARING SERVERS

To place the performance of the new HP NetServer in perspective, we invited back a Compaq ProLiant 2000 5/66 M4200A—the Editors' Choice winner in our March 15 roundup of application servers—and tested it in single- and dual-Pentium/66 configurations. We connected the servers to an actual network of 60 clients divided into four segments and ran ServerBench 1.0, which includes a processor and memory subsystem test, five hard disk tests, and two network tests. We calculated an overall score for each system by determining the weighted harmonic mean of the various scores, emphasizing the processor and disk scores. For a more detailed description of our testing process, consult the sidebar "How We Tested" in our March 15 issue.

In general, the Pentium/90 server performed as we expected, delivering more processing power and network throughput than the single-Pentium/ 66 systems but less than the dual-Pentium/66 configurations. The Pentium/90 system reached a peak at 17 transactions per second under a client load of eight workstations and trailed off slowly after that. This level of performance was about 20 percent higher than that of the single-Pentium/66 systems. As good as the Pentium/90 system was, though, it was no match for the dual-Pentium/66 servers from Compaq and HP.

The 90-MHz system evidenced a 50 percent performance gain over its 66-MHz competitors on the processor test. On the network interface tests, each Compaq configuration performed very well against its HP counterpart, reflecting the superiority of the Compaq Triflex architecture and the company's NetFlex network interface cards. The disk subsystem test results, in which the dual-Pentium/66 servers from Compaq and HP predictably overpowered their single-Pentium cousins, may be somewhat misleading because we tested under the default parameters for SCO Unix, which specifies a 6.5MB cache for single-processor systems and a 64MB cache for multiprocessor systems.

In your quest for the best server, don't count the HP NetServer out just yet. At $26,287, the HP NetServer 5/66 LM is priced competitively, as is HP's dual-Pentium configuration; its $30,587 price tag compares with the $30,392 you'd pay for the similarly equipped dual-Pentium/66 Compaq. At $28,187, the HP NetServer 5/90 LM is less expensive than either dual-Pentium/66 system, making it a potential value choice for midsize networks. HP is planning to introduce Pentium/100 and dual- Pentium/100 configurations as Pentium production ramps up.□



▸ **HP NetServer 5/90 LM,** List price (tested configuration): *$28,187.* Configuration: *Pentium/90, 128MB RAM, 256K external cache, four 1GB Fast SCSI-2 hard disks, HP SCSI disk array with 4MB cache, 1.44MB floppy disk drive, HP D2992A CD-ROM drive, four NE3200 Ethernet boards, 386-watt power supply.* Hewlett-Packard Co.; 800-322-4772; fax, 208-344-4809.

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▶ SUMMARY OF FEATURES ENDS

90-MHz Pentium PCs

Products listed in alphabetical order ■ = YES □ = NO	Ambra DP90 PCI	Dell Dimension XPS P90	Dell OmniPlex 590	HP Vectra XU 5/90C	Micron P90PCI	ZEOS Pantera 90
				PC MAGAZINE	PC MAGAZINE	
List price (tested configuration)	$4,299	$3,999	$6,699	$7,237	$4,099	$3,495
Hard disk capacity and interface	528MB IDE	1GB IDE	535MB SCSI-2	340MB IDE	530MB IDE	528MB IDE
Dealers/Direct-distribution channel	□■	□■	□■	□■	■■	■■
Case style	Desktop	Desktop	Desktop	Desktop	Desktop	Tower
Power supply (and number of connectors)	200W (4)	200W (7)	224W (3)	120W (5)	230W (7)	200W (7)
DOS, Microsoft Windows version	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows 3.1	DOS 6.2, Windows for Workgroups 3.11	DOS 6.21, Windows for Workgroups 3.11	DOS 6.2, Windows for Workgroups 3.11
Warranty	1 year	1 year	1 year	3 years	1 year	1 year
On-site service charge	$29 (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	Included (1 year)	$49 (1 year)
Processor and Memory						
Bus architecture (primary, secondary)	ISA, PCI	ISA, PCI	EISA, PCI	ISA, PCI	ISA, PCI	ISA, PCI
Motherboard manufacturer	Intel	Intel, Dell	Dell	HP	Micronics	ZEOS
Chip set manufacturer	Intel	Intel	Intel	Intel	Intel	Intel
Processor upgrade path	ZIF	ZIF	Standard	ZIF	ZIF	ZIF
BIOS version (or date)	AMI (3/9/94)	AMI (11/11/92)	Phoenix (2/19/94)	Phoenix CA.05.07	Phoenix 4.03	Phoenix/Quedtel 4.02
Flash memory/16550 UART support	■■	■■	■■	■■	■■	■■
Installable system RAM	2MB–128MB	8MB–128MB	8MB–192MB	8MB–256MB	8MB–128MB	4MB–192MB
External RAM cache	256K	256K	256K	256K–512K	256K–512K	Up to 512K
Cache architecture	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped	Direct-mapped
Cache write design	Write-back	Write-back	Write-back	Write-back	Write-back	Write-back
Components						
Available hard disk sizes	340MB–2GB	340MB–1GB	210MB–2GB	106MB–4.2GB	340MB–2GB	214MB–2GB
Disk controller location	Motherboard	Motherboard	Motherboard (PCI)	Motherboard (PCI)	Motherboard (PCI)	Motherboard (PCI)
Accessible drive bays (5.25", 3.5")	3, 1	3, 0	3, 0	2, 1	3, 0	4, 0
Internal drive bays (5.25", 3.5")	0, 2	0, 2	0, 1	0, 1	0, 2	2, 4
Floppy disk drives	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB
CD-ROM drive	Philips CM 206	Panasonic CDR-563	Toshiba XM-3401TA	Toshiba XM-4101B	Mitsumi CRMC FX0001D	Mitsumi CRMC FX0011D
ISA, EISA, MCA slots	5, 0, 0	5, 0, 0	0, 5, 0	4, 0, 0	5, 0, 0	5, 0, 0
VL-Bus, PCI, proprietary local-bus slots	0, 3, 0	0, 3, 0	0, 2, 0	0, 2, 0	0, 3, 0	0, 3, 0
Parallel, serial, mouse ports	1, 2, 1	1, 2, 1	1, 2, 1	1, 1, 1	1, 2, 0	1, 2, 0
Display circuitry location	PCI card	PCI card	Motherboard (PCI)	PCI card	PCI card	PCI card
Video chip set manufacturer	Weitek	S3	ATI	Matrox	Matrox	Weitek
Video RAM	2MB	4MB	2MB	2MB	4MB	2MB

design so that you have a product a generation ahead of the pack is another. With the HP Vectra XU, Hewlett-Packard Co. has really pushed the envelope.

The motherboard has three sections. Beneath the hinged power supply, the right side of the motherboard integrates not one, but two ZIF sockets for an eventual processor upgrade; the system can handle 256MB of RAM.The left side incorporates four ISA and two PCI slots (one shared). This is one of the few PCs in the group that doesn't have its slots blocked by its memory banks or CPU. Down the middle, under the hard disk, lie the chip sets controlling the integrated SCSI-2 adapter and two network ports, one Ethernet and one Token-Ring.

The unit posted the highest processor score here and—equipped with a PCI-based Matrox MGA video adapter—the best Graphics WinMark score. A very close second-place showing on our Winstone test and an above-average Disk WinMark score show the unit to be one of the stronger Windows performers in this roundup. DOS disk and DOSmark scores were the lowest here, though, and the unit turned in an unimpressive DOS video score as well—an expected showing, given the presence of the Matrox board. The system has video integrated onto the motherboard in the form of an S3 Vision-864 chip, but HP chose to bypass it and install the more powerful Matrox graphics accelerator.

The advanced design and excellent Windows performance of the HP Vectra XU make it a standout in this group. With dual-Pentium and networking capabilities built in, this is a well-thought-out machine with a design for the future.—*WPF*

Micron Computer Inc.

PC EDITORS' CHOICE

Micron P90PCI

With the $4,099 Micron P90PCI, Micron Computer has built on the momentum of its other PCs by boosting processor performance, and has again come up with a system that takes Windows performance

SO WHAT DO YOU WANT FOR $2,999?

THE PRICEPOINT WEEKLY

Dell's Pentium entry leads pack in price, value

By Randy Wussler

Dell Computer Corp. instantly leapt into the price leadership position of the Pentium market with the release of the 90MHz Dimension XPS P90.

With an initial $2,999 street price and a configuration featuring a CD ROM and 1M byte of video RAM, the model looks to be an even better value than 60MHz entries from Gateway 2000 and Packard Bell. Dell told us that we could expect delivery of the new system within eight days of our order.

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CIRCLE 284 ON READER SERVICE CARD

to the next level.

The system's motherboard and design are similar to those of the Micron 486DX4 system profiled in this issue's DX4 roundup. The Micronics motherboard has five ISA and three PCI slots; one of the slot spaces is shared. The voltage converter required to drive the 3.3-volt Pentium-/90 processor is integrated onto the motherboard, although it uses a fairly large heat sink. The heat sink stays relatively cool during operation.

On our benchmark tests, the Micron P90PCI performed exceptionally well under Windows but proved to be only an average performer under DOS. The system's processor score was average, but its 530MB Conner hard disk helped it to post the best score on our DOS disk tests (DOS disk scores were closely spaced together, though). The Micron P90PCI's DOSmark score was well below average, however, due in part to its laggard showing on our DOS video tests. The system uses a Matrox MGA-PCI/2+ video board, which is known for its stellar performance under Windows but poor performance under DOS.

The system's components and general design dazzled under Windows. Its Disk WinMark score was the highest of the group and more than 20 percent higher than that garnered by the next closest system, the ZEOS Pantera 90. The Micron P90PCI's Winstone score was the best of the group by a much closer margin. Although its video subsystem had 4MB of VRAM, it placed second to the HP Vectra XU 5/90C, which had the same video card but only 2MB of memory. The extra memory will come in handy if you want to boost the display's resolution, however.

This system should be strongly considered by anyone who needs a high-end Windows workstation or graphics system. Micron hasn't strayed far from the design of its other systems; it's just taken their best elements to the next plateau.—*WPF*

▶ FACT FILE

Micron P90PCI

List price: $4,099 **Processor/memory:** Pentium/90, 16MB RAM, 512K external cache **Data storage:** Conner 530MB IDE hard disk with 256K cache, integrated PCI disk controller, Mitsumi CRMC-FX0001D CD-ROM drive **Display:** Matrox MGA-PCI/2+ PCI local-bus video controller card with 4MB VRAM, MAG DX15F 15-inch monitor with a 76-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.21, Microsoft Windows for Workgroups 3.11, Microsoft Office. **In short:** Like its DX4-based siblings, the Micron P90PCI combines an excellent design with quality components to create a powerful Windows machine. Though it was not a strong performer on our DOS video tests, the unit provides plenty of performance for its price.

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SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	EXCELLENT
Expandability	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
Repair service	AVERAGE
Technical support	ABOVE AVERAGE

ZEOS International Ltd.

• ZEOS Pantera 90

Although the ZEOS Pantera 90's test results were not the most spectacular here, the system does provide a good performance boost over 60- and 66-MHz Pentium PCs. But where the ZEOS Pantera 90 really excels is in value: You pay just $3,495 for a 90-MHz Pentium tower system.

This unit's case is massive, with a total of ten drive bays. One look inside the system and the first thing you notice is how small the motherboard is. This is not a bad thing, however. The ZEOS motherboard, while tiny, is well laid out and offers what you would expect from the motherboard of a tower case with five ISA and three PCI slots. Unfortunately, though, three of the ISA slots cannot accept full-length cards because of the location of the CPU. To bridge the gap between the 5-volt motherboard and the 3.3-volt Pentium/90 chip, the CPU is mounted in a ZIF socket on a voltage regulator module that itself fits into the motherboard's ZIF socket. The extra height interferes with the ISA slots.

In terms of performance, the tested machines were grouped pretty closely together. So while the ZEOS Pantera 90 did not produce top numbers in any one category, it did perform competitively. The unit's DOSmark score was below average, but its processor score was on a par with the scores earned by the majority of the systems in this group. On our DOS disk tests, the ZEOS Pantera 90—equipped with a 528MB Seagate drive—performed a little above average. Its disk subsystem also helped it post an above-average score on our Disk WinMark tests (but this result was considerably closer to third place than it was to first). The ZEOS Pantera 90's scores on our DOS video and Graphics WinMark tests were both below average, due in part to the unit's Diamond Viper PCI–based video subsystem. Its Winstone score was below average as well.

For $3,495, the ZEOS Pantera 90 is an excellent purchase; it offers consistent performance under both Windows and DOS, as well as an almost unlimited amount of expansion room.—*WPF* □

▶ FACT FILE

ZEOS Pantera 90

List price: $3,495 **Processor/memory:** Pentium/90, 16MB RAM, 256K external cache **Data storage:** Seagate Technologies 528MB IDE hard disk with 256K cache, integrated PCI disk controller, Mitsumi CRMC-FX0011D CD-ROM drive **Display:** Diamond Computer Systems Viper PCI local-bus video controller card with 2MB VRAM, ZEOS Color SVGA 15-inch monitor with a 75-Hz refresh rate at 1,024-by-768 **Software:** DOS 6.2, Microsoft Windows for Workgroups 3.11, choice of: Lotus Ami Pro, Lotus Approach, Lotus Freelance Graphics, Lotus Improv, Lotus 1-2-3 for Windows, Lotus Organizer. **In short:** Adequate performance and a nice price might for some add up to a good value choice.

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SUITABILITY TO TASK	
DOS applications	FAIR
Windows applications	EXCELLENT
Expandability	GOOD
VENDOR SERVICE & RELIABILITY	
Reliability	ABOVE AVERAGE
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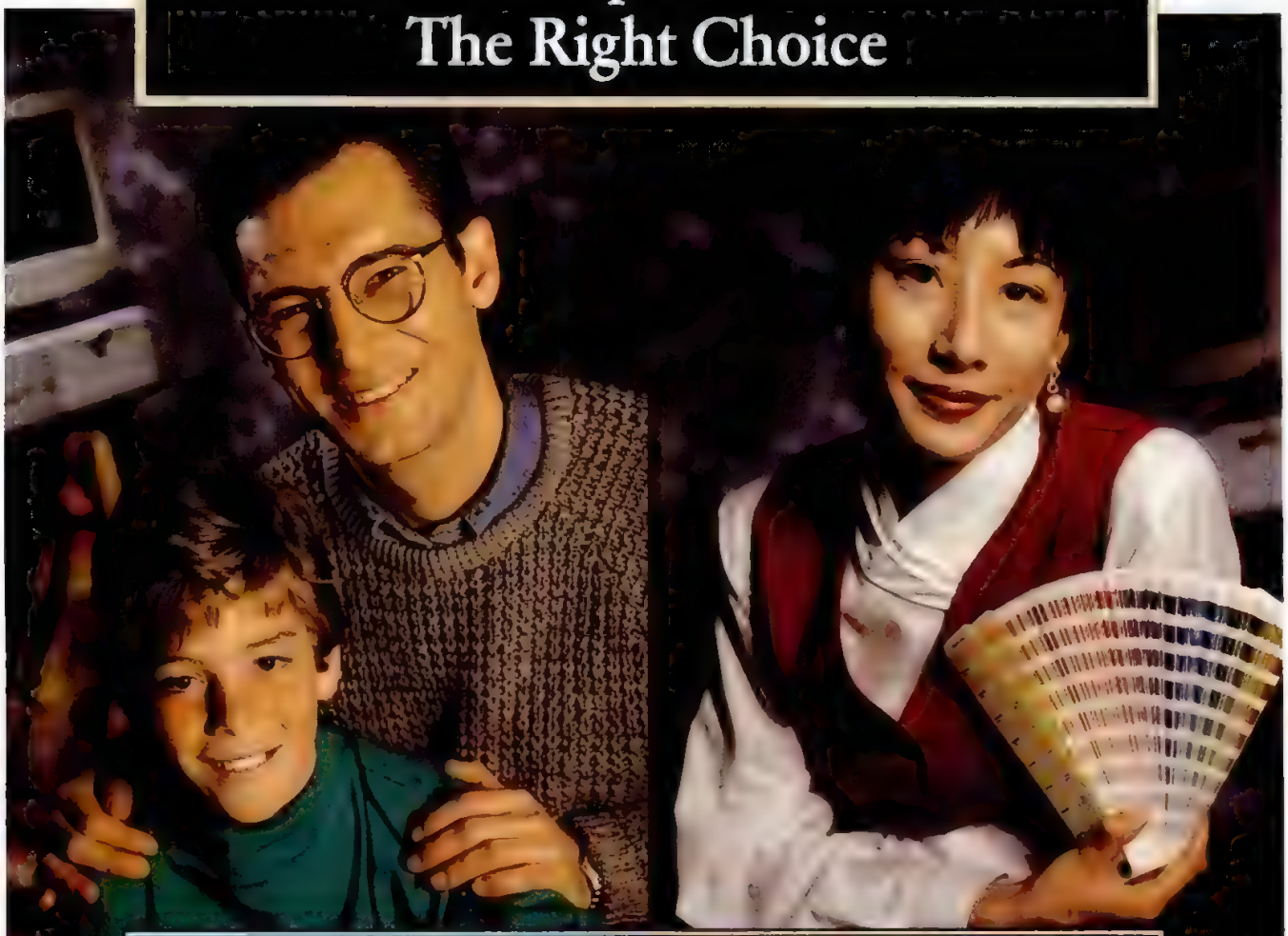

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GRAPHICS ACCELERATOR BOARDS

Bit Blasters

This group of powerful graphics accelerator cards have a bounty of useful features specifically aimed at today's computer graphics professionals.

By James Karney

This roundup is a bit like a grand prix auto race: not your average drive around the track, but lots of fun to watch. We tested the best graphics accelerator cards on the market today—cards designed to please the serious computer graphics user. Nobody demands more from a GUI display like Microsoft Windows than these professionals. They need high performance at high resolutions in true-color modes for resource-intensive tasks such as desktop publishing, CAD and 3-D modeling, image editing, and multimedia presentations. These are tasks that push your system to its limit.

Like automakers, graphics card vendors use the performance and features of their top designs to showcase their best engineering and to test the designs under extreme conditions. They use state-of-the-art hardware and provide the slickest software and drivers available. The features found in these reviews are demanded now by professionals, and will soon find their way onto the wish lists of average users; vendors will most likely start adding them to midrange products. After all, having a fast display system is not only fun, it's more productive.

To help make sense of all the chips and board types, we grouped products from a single vendor that use the same accelerator chip into one review (including all bus types). We cover vendors with two or more boards that use different chips in multiple reviews. Our Suitability to Task ratings can help you sort out the relative strengths and weaknesses of the different products for the type of work you do.

Graphics accelerator technology is rapidly evolving. The 32-bit coprocessors of three years ago were replaced by 32-bit dedicated accelerators, which are now being replaced by new 64-bit engines.

Illustration by Joe VanDerBos

In May 1993, Matrox Graphics was the first to market with a card featuring a 64-bit graphics accelerator chip, the Multi-Media Graphics Architecture (MGA). Matrox's lead time over its rivals is evident in both the stability of the MGA driver and the chip's top benchmark test scores. Boards based on 64-bit engines from other vendors are starting to give Matrox some real competition. Matrox was also the first out of the gate with a PCI card and now the other vendors are following suit. (For more information about PCI versus VL-Bus, see the sidebar "Bus Effects: New Paths to Your CPU.")

While the graphics engine is an important part of a graphics card, it is only part of the story. To get the most out of these chips you need supporting hardware, excellent drivers, and for the graphics professional software enhancements that boost productivity. All of these boards use VRAM; most have 4MB of it. Beware of 64-bit graphics accelerators with less than 2MB of VRAM: They can't take full advantage of the extra bandwidth and, as a result, are a waste of money.

A true-color display system has to be able to produce 16.7 million colors, or 24-bits of color. True color produces continuous tones and near-photographic quality on-screen, illustrations are free of the posterization often found in VGA renditions, and bitmapped images have better saturation and contrast. The 24-bit boards (remember, this is not the same as the bandwidth of the accelerator engine) have to provide three 8-bit channels per pixel, one for each of the primary colors used by the monitor: red, green, and blue (RGB). To get the data to the monitor in a form it can use requires a digital-to-analog converter (DAC). Optimally tuning the engine, DAC, and memory is a factor in performance, and so is the quality of the board's drivers.

Because Windows does not have built-in true-color support, graphics board manufacturers must write and test their own 24-bit drivers and installation routines. How well a driver uses the accelerator engine's features has a lot to do with how fast and how well the card performs its tasks. Poor drivers will not only decrease speed, they can also make the system more prone to crashing. The early true-color cards were known for having high price tags, challenging installations, and frequent operating bugs. This new crop shows dramatic improvement.

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QUALITY OF LIFE

Putting together a high-performance display subsystem requires properly matching the right graphics board and the right size monitor with the type of graphics work you do. The not-so-subtle extras, such as refresh-rate settings and software controls, can make a real difference in how pleasant and comfortable it is to stare at your monitor for an extended period of time. Some boards offer a wider range of user-selectable monitor refresh rates than others. Of course, you'll need to have a monitor that can handle the extra bandwidth. Custom monitor adjustment controls let you precisely match the adapter card's refresh rate with that of the monitor.

HIGHLIGHTS

Graphics Accelerator Boards

DON'T BELIEVE EVERYTHING you hear. We found that many of the graphics boards scheduled for evaluation could not support 1,024-by-768 resolution in 24-bit color or did not not come with working drivers to run our test suite. Thus, only 18 boards out of the original list of 55 made it into this roundup.

64-BIT CHIP TECHNOLOGY is rapidly taking over the market. On our tests, boards using 64-bit accelerators consistently outperformed other boards, including those with superior drivers.

MOST BOARDS using the same accelerator chip performed similarly on our performance tests. Any disparities usually depended on a board architecture or driver implementation.

SPEED ISN'T EVERYTHING. The best graphics cards are those that offer strong AutoCAD drivers and support high resolutions and color depths for running graphics-intensive applications. Features such as mode switching, special CAD drivers, and strong color calibration also separate the best cards from the rest of the competition.

MATROX'S MGA IMPRESSION and MGA Ultima Plus boards turned in the best overall performance of all the graphics accelerator boards we evaluated, thanks to stable, powerful CAD drivers and high-resolution support.

THE FUTURE lies with PCI. For the most part, PC Labs found PCI-based graphics accelerator boards to be faster and easier to configure than their VL-Bus–based counterparts. PCI boards are also cheaper to implement.

Many of today's engines support a 1,600-by-1,200 resolution in up to 16-bit color, and 1,280-by-1,024 in 24-bit color. You can use that area directly or as a virtual desktop on monitors such as the 17-inch NEC MultiSync 5FG. This feature can be a real advantage to desktop publishers who want to view two-page spreads without springing for a 21-inch monitor.

Before you say that the type at 1,600 by 1,200 pixels on a 17-inch monitor is unreadable, investigate the mode-switching features offered on ATI Technologies and Matrox boards. Mode-switching utilities allow you to change both resolution and pixel depth on-the-fly—without leaving Windows or closing an application. This means that you have the ability work in 8-bit modes for non-critical work, then change to 24-bit mode or a different resolution for a higher level of detail via a simple keystroke. But don't confuse this feature with the simple control panels that allow you to select new driver modes. Some graphics vendors claim Windows switching, but their software requires that you exit all applications and reload Windows to effect the change—a big difference in both time and effort.

TRUE COLOR

Knowing the exact color on the screen is critical in high-end graphics work, and more vendors targeting this market are providing color-calibration tools. The best allow fine-tuning of gamma, brightness, and contrast for each color channel. The aim is to match the color on the screen with the final result from the printer. The expense of repeating color separations or a press run can quickly kill a budget. The standard of excellence is the color-matching tool shipped with SuperMac cards: It controls the output of the DAC to the RGB guns. Matrox's tools are not quite as robust, but they can be paired with an external monitor probe for improved accuracy.

Vendors are doing other things with color to succeed in the professional market. Matrox provides a sophisticated driver mode with on-the-fly dithering, which can produce 256-color images that look virtually identical in quality to true-color

PC MAGAZINE EDITORS' CHOICE

• MGA Impression
• MGA Ultima Plus

Even if raw performance were the only measure by which we judged these graphics accelerator boards, Matrox Graphics' MGA Impression and MGA Ultima Plus boards would still be our Editors' Choice winners. However, the needs of high-end graphics professionals go beyond blasting images to the screen; these professionals also need special drivers for high-end applications, easy mode switches, and stable high-resolution support. Once again, both the MGA Impression and MGA Ultima Plus provide these capabilities.

Based on Matrox's MGA 64 accelerator chip, the MGA Impression board comes in both ISA and VL-Bus flavors, while the MGA Ultima Plus comes in VL-Bus and PCI flavors. The Impression board features the most stable 24-bit Microsoft Windows drivers and the cleanest AutoCAD drivers we saw (including useful CAD features such as sizable, pinnable text window; sizable bird's-eye window; real-time 3-D spyglass zooms; and custom menu generators). All of these Matrox boards also offer on-the-fly mode switching, which allows you to see how your work looks in different resolutions without leaving Windows. Yes, this mode switching may slightly compromise the resolution or color depth of your system, but in combination with the Matrox boards' other stellar features, it can be a truly valuable tool. The one area in which the Matrox boards fell short was DOS video performance. Unless you're designing a graphics-intensive DOS-based game, however, those numbers shouldn't alarm you.

Of course, the Matrox boards were not the fastest boards on *every* test. Another company that appeared regularly atop our test results was Diamond Computer Systems. Its Diamond Stealth 64 card, based on the S3 Vision964 accelerator chip, was right behind the Ultima Plus on the Graphics WinMark tests and effectively tied the Ultima Plus in Winstone performance. Those numbers and a smooth installation routine earn the Stealth card an honorable mention. Unfortunately, the Stealth fell short of top honors because its software and driver implementation for professional graphics tools just isn't on a par with those found in our Editors' Choice products. The Diamond Viper Pro, based on the Weitek P9100 chip, also had some strong numbers, especially on our Winstone test, but its dearth of high-end graphics tools leaves it well behind the other Diamond boards in this roundup.

Since performance and benchmark test scores among the top three boards were relatively close, ATI Graphics Pro Turbo scores should still be considered quite strong, and the VL-Bus version gave the best performance for its bus type on our Winstone test. Its strong numbers; excellent color, brightness, and sharpness; and easy installation garner the ATI Graphics Pro Turbo an honorable mention as well. To make the product worthy of an Editors' Choice honor, ATI will have to stabilize the board's drivers and provide much better implementation and documentation for some of the add-on utilities.

Scores for the Number Nine #9GXE64 Pro were respectable on most tests, but they still fell a touch below those of our Editors' Choice winners and honorable mentions. On the other hand, it had the best DOS video performance of any PCI board we tested. Though that may mean little to graphics professionals, the Number Nine board's strong Windows utilities, such as its intelligent virtual screen feature, should prove more appealing.

Suitability to Task: Graphics Accelerator Boards

CAD, raster graphics, vector graphics, and mainstream usability in the Microsoft Windows environment are the four categories in which we rate these graphics accelerator boards. Beyond looking at raw speed, we evaluate the specific tools and enhancements these products offer for the high-end graphics professional.

We require each graphics accelerator card to ship with AutoCAD drivers in order to receive a rating for our **CAD** task. Products without such drivers receive an N/A. We look at each board's ability to accelerate normal CAD operations such as text zoom, redraw, and pan and zoom in 2-D and 3-D. We also look for extensions to the AutoCAD environment such as bird's-eye zoom, scrollable text boxes, and palette handling. AutoCAD drivers that poorly manage the display list or leave remnant pixels on the screen after a move or regeneration receive low ratings.

To receive an *excellent* rating in **raster graphics**, a board must provide a means to color-calibrate its output to the monitor, perform gamma correction for varying lighting conditions, and accelerate a variety of BitBlts (bit-block transfers). Higher resolutions at true color and high refresh rates figure into this task evaluation as well.

For **vector graphics** performance, we require each board's drivers to interpret and intercept a wide variety of Windows GDI calls that make up the spectrum of vector operations, including the more esoteric operations only found in vector functions, to receive any rating at all. But to garner a *good* or an *excellent* rating, a product must provide useful features for artists, such as a virtual desktop with hardware pan and zoom. We also consider font caching and rendering routines in the context of this task. These features are especially useful for desktop publishers who work with complex text treatments alongside graphical elements.

Our **mainstream usability** score is derived from a combination of the installation, the stability of the drivers, and the value and usability of add-ons. To score well on this task, a product must install without a hitch and should include thorough documentation. Products that provide preset modes for different monitor brands, automatic or selectable refresh rates, a user-definable setting for fixed-frequency monitors, and an electronic means for storing settings, such as an on-board EEPROM, earn an *excellent* rating. Boards that suffer general power failures or leave artifacts while running Windows with a normal load of applications and processes receive our lowest rating.

SUITABILITY TO TASK	Company Name
CAD	POOR
Raster graphics	FAIR
Vector graphics	GOOD
Mainstream usability	EXCELLENT

images. There is a performance cost, but for multimedia and other non-critical applications where the viewer does not have to manipulate pixels precisely, this mode offers an advantage.

In the future, we'll see vendors bundling more features with their cards in an effort to please buyers and gain market share as prices drop. Users will come to expect the current enhancements as standard features. Average users salivating over the innate power of these high-end cards will also be glad to hear to that street prices of some are now below $500. In fact, major PC suppliers from Compaq to ZEOS are already responding to the demand by signing OEM agreements with graphics board vendors. They are offering many of the boards in this roundup as options, if not as part of the basic configuration of their new systems.

STRAP YOURSELF IN

All of this sounds like great news for graphics professionals and power users alike. But don't rush out and buy a graphics card just on the basis of a pretty magazine ad or brochure. As we were preparing for this roundup, we saw more than a few vendors crash and burn before even making it to the starting line.To enter our competition a product had to be capable of running Windows at a resolution of 1,024 by 768 pixels in true-color mode (16.7 million colors). The boards also had to be shipping products with FCC Class B certification, and be able to run both WinBench 4.0 and Winstone 94, Version 1.0, without crashing.

That may seem like a simple set of tests, but of 55 cards offered for this evaluation, only 18 made it into the final roundup. The survivors are from ATI, Diamond Computer Systems, ELSA, Matrox, Media Vision, miro Computer Products, Number Nine Computer Corp., STB Systems, and SuperMac Technology. The rest either failed to show up, were obviously not ready to ship, did not work on our test platform, or could not complete the benchmark tests. One card even came in with all identifying marks sandpapered off of the chips—not exactly the sign of a shipping product.

Part of the reason for this kind of behavior is the pressure to rush products to market. Manufacturers are trying to bring out new products as soon as possible, leading some to send immature products to be tested alongside fully developed ones. Some boards looked ready, but had obviously not been tested enough to operate reliably. The drop-out rates show just how volatile the graphics market is right now. The underlying problem is the complexity of building a quality high-end product. The 64-bit engines are new. Putting boards together, writing solid Windows and CAD drivers (especially 24-bit drivers), and properly engineering the hardware on the board takes time and resources. Keeping up with the trend to bundle software enhancements adds to the challenge. Those companies that made it through our testing with high scores and received favorable reviews are generally firms with a respected track record and good engineering skills.

This market segment of the PC industry is undergoing a major shift. There used to be a line that divided high-end graphics board vendors from the larger pool of high-volume firms. That line has all but disappeared. Established high-end vendors, such as Matrox and Number Nine, are finding that rising user expectations coupled with falling prices are forcing

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Bus Effects: *New Paths to Your CPU*

By Winn L. Rosch

PC performance under today's 24-bit applications depends on three factors: the microprocessor, the graphics accelerator, and how they are connected—the bus, that is. Installing the right bus in your system can ensure a substantial increase in performance.

For a decade, the basic bus choice has been Industry Standard Architecture (ISA). In fact, most of the systems in corporate America today are ISA-bus machines. Created by IBM Corp. to work with the 286 microprocessor (a chip with about 1/25 the data throughput of a Pentium or DX4), ISA offers only a 16-bit data path and a nominal speed of about 8 MHz. Lacking a true burst mode, ISA requires two clock cycles for each 16-bit word it transfers: one to set an address, and one to move the information, yielding a peak transfer rate of 8MB per second.

You will find more PCs and peripherals using VL-Bus simply because it's a year older. Age is not always a virtue, however.

Two early attempts at better bus designs, Micro Channel architecture (MCA) in 1987 and Extended Industry Standard Architecture (EISA) in 1988, failed to win wide acceptance. Each added a 32-bit data path, arbitration, and different clocking to the ISA design. MCA pushed the peak transfer rate to 20MB per second, while EISA pushed it to 33MB per second. Both, however, are inadequate for today's chips. Advanced modes can push performance higher, but they require special PCs, drivers, and peripherals, and few manufacturers have bothered with them.

CATCH THE LOCAL BUS

VESA Local Bus (VL-Bus), introduced in 1992 by the Video Electronics Standards Association, gave the PC industry an accepted standard for a local-bus connection: a bus that matches a system's microprocessor speed and data path. The bus design was quickly adopted by many mainstream, direct marketers and incorporated into a large number of PCs sold in the last two years.

Designed to augment a traditional bus (ISA, EISA, or MCA), VL-Bus allows bus mastering, in which an expansion board takes control of bus transfers and frees up a PC's microprocessor for other jobs. But VL-Bus is strictly a 5-volt design and has no inherent, automatic configuration provisions such as plug-and-play.

VL-Bus was patterned after the leading chip of the time, the 486DX/2. Though the standard sets no upper speed limit, VL-Bus should work at 66 MHz, and most systems optimize their clocks at 33 MHz of the DX/2 chip and use its 32-bit data path.

VL-Bus normally uses two cycles per transfer of a 32-bit word to peak at 66MB a second. But it also supports 486-style burst mode, in which a single address cycle precedes four data cycles. Four 32-bit words move in only five cycles, each at 105MB per second at 33 MHz. The VL-Bus 2.0 extension pushes speed to 50 MHz and broadens the bus to 64 bits, which is good for 320MB-per-second bursts.

THE PCI SOLUTION

In July 1992, Intel Corp. introduced Peripheral Component Interconnect (PCI) as a blueprint for directly connecting microprocessors and support circuitry, and then extended the design to a full expansion bus with Release 2.0 in 1993. Popularly termed a *mezzanine* bus, PCI 2.0 combines the speed of a local bus with microprocessor independence. It can support chips as diverse as the DEC Alpha and the PowerPC, as well as those in Intel's own line of processors.

Personal computers may use PCI buses in conjunction with traditional buses or by themselves. The PCI design includes full arbitration, automatic configuration, error control (parity checking of data and address signals), and provisions for 3.3- or 5-volt circuitry.

The PCI 2.0 standard foresees operation in a frequency range of 20 MHz to 33 MHz and defines both 32- and 64-bit implementations. PCI is a time-multiplexed bus (address and data lines share connections), and each nonburst bus transfer requires two clock cycles to complete. But PCI also has its own burst mode, in which a single address cycle can be followed by a number of data cycles constrained only by system overhead. These bursts approach a one-word-per-cycle transfer speed, or 264MB per second.

Which is better, VL-Bus or PCI? You will find more PCs and peripherals using VL-Bus simply because it's a year older. Age is not always a virtue, however. PC Labs found PCI boards much easier to configure, particularly because they do not require the assignment of a memory range for their BIOS extensions. Moreover, many system and peripheral vendors believe PCI boards will eventually be less expensive to produce simply because they require fewer parts. By the time you read this article, some computer manufacturers may have already shifted from VL-Bus to PCI boards. You may want to follow their lead to stay ahead.□

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GATEWAY DX2-66	38.1	3,753	947	2.7	830
486DX2-66 average	39.7	3,359	1,050	9.5	861

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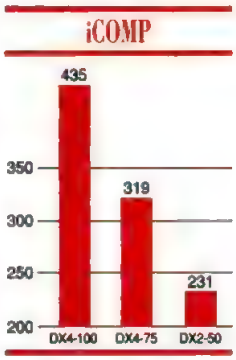

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- 4MB RAM, max: 36MB
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- 240MB IDE hard disk
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- Local bus IDE controller
- Local bus graphics, 1MB
- 14" SVGA color monitor, LR

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D466DXA
- 486DX2, 66 MHz
- 128KB L2 cache, max: 256KB
- 4MB RAM, max: 36MB
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- 6 drive bays
- Fast PCI IDE controller
- PCI graphics, 2MB
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- 15" FST-NI color monitor, LR

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mass-market vendors to encroach on their territory. Meanwhile, high-volume leaders, such as ATI and Diamond, are watching the makers of expensive specialty cards move into their markets, seeking a piece of a bigger pie.

HAVE FUN, BE CAREFUL

That's both good news for buyers and a reason for caution. On the positive side, the price of a new 1,024-by-768 true-color card is about one-sixth that of two years ago. Another plus is performance. As you can see from the scores on our tests, the high-end true-color race is definitely on. While Matrox has taken an early lead by winning our Editors' Choice, ATI, Diamond, and Number Nine made very respectable showings.

Cost and performance are prime considerations, but they're not everything. In reading the reviews, you should look beyond the benchmark test results and raw pixel-pushing power. The wise consumer will examine the enhancements and suitability to specific tasks that his or her job requires. Mode-switching, special CAD drivers, and color calibration may be bigger incentives to many buyers than a 5 percent difference in Graphics WinMark scores, or $75 difference in street price. The trick is finding just the right set of features that meet your needs from a vendor you can trust to deliver support. Shop wisely and start your engines.

ATI Technologies Inc.

• ATI Graphics Pro Turbo

BY JAMES KARNEY

The ATI Graphics Pro Turbo PCI and VL-Bus graphics accelerator cards make an impressive entry into the realm of high-resolution true color for ATI Technologies. These offerings include the company's new ATI mach 64 64-bit engine and matching 64-bit digital-to-analog converter (DAC) capable of producing 24-bit color at resolutions of up to 1,280 by 1,024 pixels. While neither of the Graphics Pro Turbo cards earned top scores on our tests, their clean, consistent performance make them strong competitors in the high-performance graphics card arena.

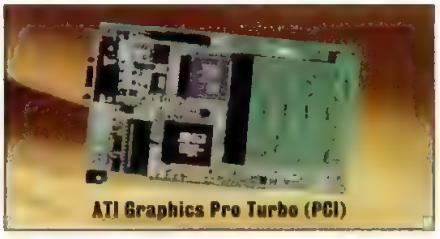
We worked with one of the first shipping versions of the Graphics Pro Turbo, and while its drivers have some rough edges and there is room for improvement with some operations, overall the unit performed well. Screen operations were crisp and the bundled software enhanced Microsoft Windows productivity.

SUITABILITY TO TASK ATI Graphics Pro Turbo	
CAD	GOOD
Raster graphics	GOOD
Vector graphics	GOOD
Mainstream usability	GOOD

The mach 64 engine is designed to push the limits of Windows, with acceleration functions for BitBlts, fills, lines, and clipping at all color depths. The VL-Bus– and PCI-based Graphics Pro Turbo cards we tested each had 4MB of VRAM. Vertical refresh rates for the boards range from 60 to 100 Hz at 640- by 480-pixel resolution and from 43 to 75 Hz at 1,280-by-1,024.

The PCI version of the card moved smoothly through most of our tests, finishing fourth on the 1,024-by-768 24-bit color Graphics WinMark tests. While the VL-Bus version led its test group in Winstone results, the PCI Graphics Pro Turbo finished just a shade behind the PCI leader, the Diamond Viper Pro. In performing Adobe Photoshop and CorelDRAW operations, both Graphics Pro Turbo cards finished in the middle of the pack, except for a first-place showing for the VL-Bus card on the Raster Graphics test.

ATI ships the Graphics Pro Turbo boards with 32-bit color drivers, which use the extra 8 bits to move data faster to the bus. An initial 32-bit driver did show better performance than ATI's 24-bit driver, but some alpha channel operations in Photoshop resulted in images without any red values in the color map. A newer 32-bit driver that ATI is shipping with all new cards fixes the problem, but it performed similarly to a standard 24-bit card on our tests.


ATI Graphics Pro Turbo (PCI)

TRUE COLORS

Of course, performance scores are only part of the story. With the boards in either 24-bit or 8-bit mode, Windows screens are crisp and the colors appear well saturated. Also, the Graphics Pro Turbo boards are among the easiest to install. Software extras include an on-the-fly resolution and color-depth changer called WinSwitch that can swap operating modes without leaving Windows. ATI's DeskScan virtual desktop utility is first-rate, allowing precise control over pan and zoom functions.

The Graphics Pro Turbo boards also offer a reasonable color-calibration routine. The controls, especially for gamma correction, are not as sophisticated as those of the SuperMac boards, and the Graphics Pro Turbo boards do not offer external color target and probe support as Matrox boards do, but they're a good start. Users would benefit from a better explanation of how to perform the calibration, which for the moment is little more than a notice that this feature exists. ATI needs to improve this utility if it wishes to interest serious color graphics professionals.

The Graphics Pro Turbo uses color interpolation to reduce blockiness when stretching video images, which can be implemented in horizontal and vertical dimensions independently. The cards can also take advantage of the motion video–acceleration enhancements built into the mach 64 engine. You can use the special acceleration drivers to control the color, brightness, contrast, and tint of .AVI clips at a maximum 1,024-by-768 resolution in 24-bit mode with 4MB of VRAM. Graphics cards with 2MB of memory are limited to 800-by-600 resolution in true color, but they can run 16-bit clips at 1,024-by-768.

The AutoCAD drivers that come standard with the Graphics Pro Turbo boards are OEM copies of the Vibrant Soft Engine F/X used by many of ATI's competitors. In general, the test scores of the PCI and VL-Bus versions place the units near the middle of the test group. We experienced no problems during our evaluation with CAD operations.

The Graphics Pro Turbo cards sport a very good design and provide solid perfor-

Performance Tests: Graphics Accelerator Boards

How We Tested

We tested 18 24-bit graphics accelerator boards using a combination of benchmark and performance tests. The performance of cards using new 64-bit accelerator engines far surpassed that of cards based on 32-bit engines.

We used a resolution of 1,024 by 768 pixels in 24-bit color mode (16.7 million colors) for all our benchmark tests (except for certain modes used in our AutoCAD tests). This is important to note when comparing the scores reported here with those presented elsewhere in the industry, based on tests run using lower color depths. Each of the boards also uses dual-ported VRAM (which is more expensive and faster than conventional DRAM) for on-board memory, and the processing cycles saved by using this VRAM assist in optimizing the rendering of complex raster and vector operations at high color depths.

In addition to running standard PC Labs benchmark tests, we created several real-world application-based performance tests designed to simulate routines commonly performed by users of high-performance graphics products. This enabled us to measure performance across several different types of graphics operations, including CAD and 3-D design and raster and vector graphics. Raster graphics refers to graphics represented by pixels, each of which can have its own color. Vector graphics are not represented by pixels; they are composed of lines, polygons, and other objects that can be grouped together and filled with color to make up a picture. The objects reside on an *x,y* coordinate system or, if the object is a 3-D vector graphic, on an *x,y,z* coordinate system.

We designed our test-bed to accommodate three bus architectures: ISA, VL-Bus, and PCI. All VL-Bus and ISA graphics boards were tested on Micron 486VL computers with Micronics EISA/VL-Bus motherboards, 16MB of RAM, and 256K L2 caches. Each unit was also equipped with a 528MB IDE Seagate ST3655A hard disk with a 256KB cache buffer and 12-ms average access time.

For our PCI test-bed, we used 60-MHz Gateway 2000 P5-60 Pentium-based PCs, each equipped with 16MB of RAM and a 256KB L2 cache. The standard configuration on these systems included a 540MB IDE Western Digital WD-AC2540H hard disk with a 128KB cache buffer and an 11-ms average access time.

We used NEC 4FG monitors for display in both test-beds. In addition, we used NEC 5FG, 17-inch Sigma ErgoView 17, and Nanao Flexscan T660i monitors to test extended features and troubleshoot problems with refresh rates encountered during testing.

We enforced compliance with VESA-standard refresh rates, using a 70.069-Hz vertical rate and a 56.476-kHz horizontal rate for 1,024-by-768 resolution. In order to use multiple CONFIG.SYS and AUTOEXEC.BAT files when booting up the systems, we used Boot Commander from V Communications.

We used selected benchmark tests from WinBench 4.0, Winstone 94 (Version 1.0), and PC Bench 8.0. Products that failed to complete these tests were dropped from the roundup unless the vendors were able to provide satisfactory new drivers or graphics boards within 48 hours.

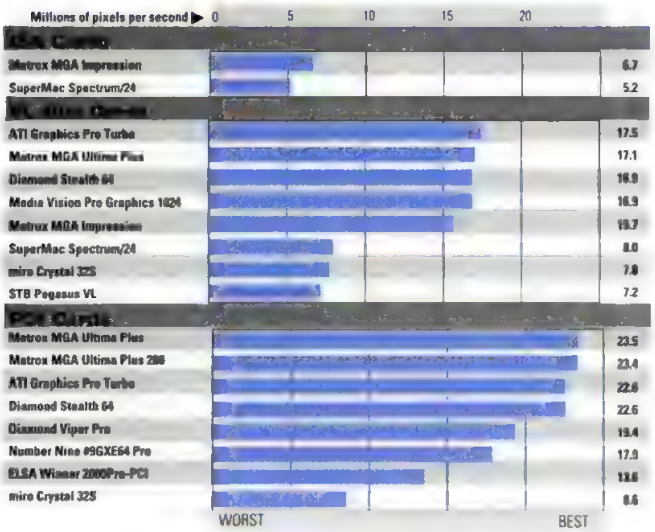
The **Graphics WinMark** score (from WinBench 4.0) is a measure of graphics board performance under Microsoft Windows 3.1. We run 66 different tests—divided into seven graphics test mixes—to evaluate each system's handling of the Windows GDI (Graphics Device Interface). These tests are based on extensive application profiling.

For this issue, we introduced a set of newly developed tools to verify the Graphics WinMark results. These tools are designed to trap any driver that attempts to trick the WinBench program into producing an artificially high score.

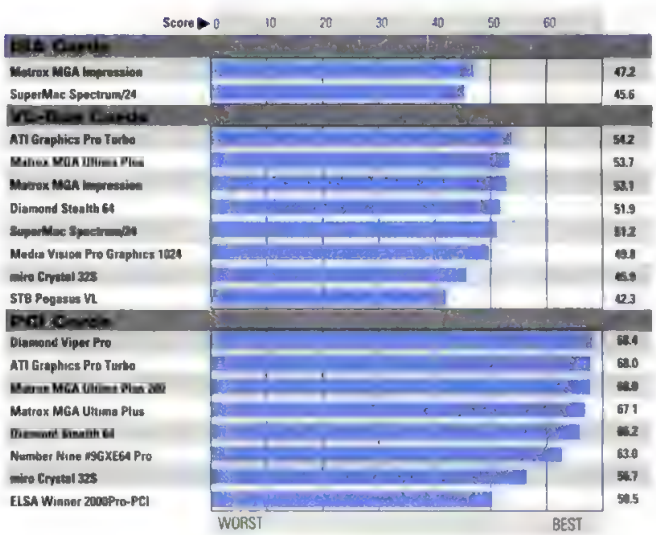
Winstone 94, Version 1.0, measures the time a PC takes to execute a set of scripts that exercise 12 of the best-selling Windows 3.1 applications. Winstone scores have been normalized relative to a Compaq Deskpro 386/25M with 4MB of RAM, which has a Winstone score of 10.0. Higher scores represent better performance; a graphics board in a similar PC with a score of 20.0, for example, will deliver twice the performance of the reference configuration when running typical Windows 3.1 applications.

The **DOS video** score is a weighted harmonic mean of tests that measure 8- and 16-bit VGA write operations involving both text and graphics. The results did not figure heavily in our final evaluation of a product's performance; any DOS-based graphic design application is likely to include special drivers that

GRAPHICS WINMARK



WINSTONE



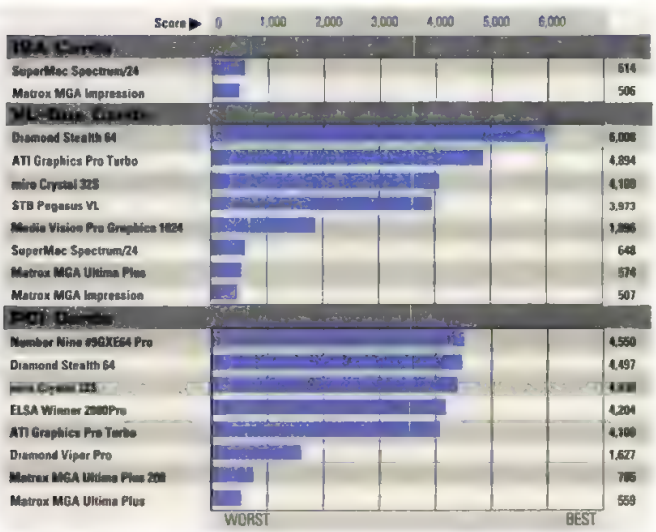
disengage the application from DOS VGA.

Our AutoCAD test suite is a version of the San Diego AutoCAD Users Group AutoCAD benchmark tests developed by Chris DeLucci. This version has been specially designed for *PC Magazine* to test only graphics operations relevant to evaluating a graphics board's performance in the AutoCAD environment. We loaded each board's AutoCAD drivers for these tests. We used the drivers and any proprietary command functions they supported for common functions such as pan, zoom, and redraw. We set the 2-D desktop display to 1,024 by 768 pixels with 256 colors and the resolution in render mode to 1,024-by-768 pixels with 16.7 million colors. The benchmark tests include normal AutoCAD operations such as 3-D pan and zoom, iconic menu display, dynamic dialog box display, text zoom, redraw, and regenerate. The **AutoCAD Dynamic Dialog** test measures the time it takes to draw several iterations of a complex dialog box. The **AutoCAD Text Zoom** test measures the time required to perform repeated zooms on an area of the test drawing that is filled with text. The **AutoCAD 3-D Zoom** test measure the time required to perform repeated ZOOM Center commands on the 3-D model. Zooms are confined to an area that does not force a REGEN (full regeneration of the image). All these tests evaluate the display-list driver's ability to manage and refresh the display list.

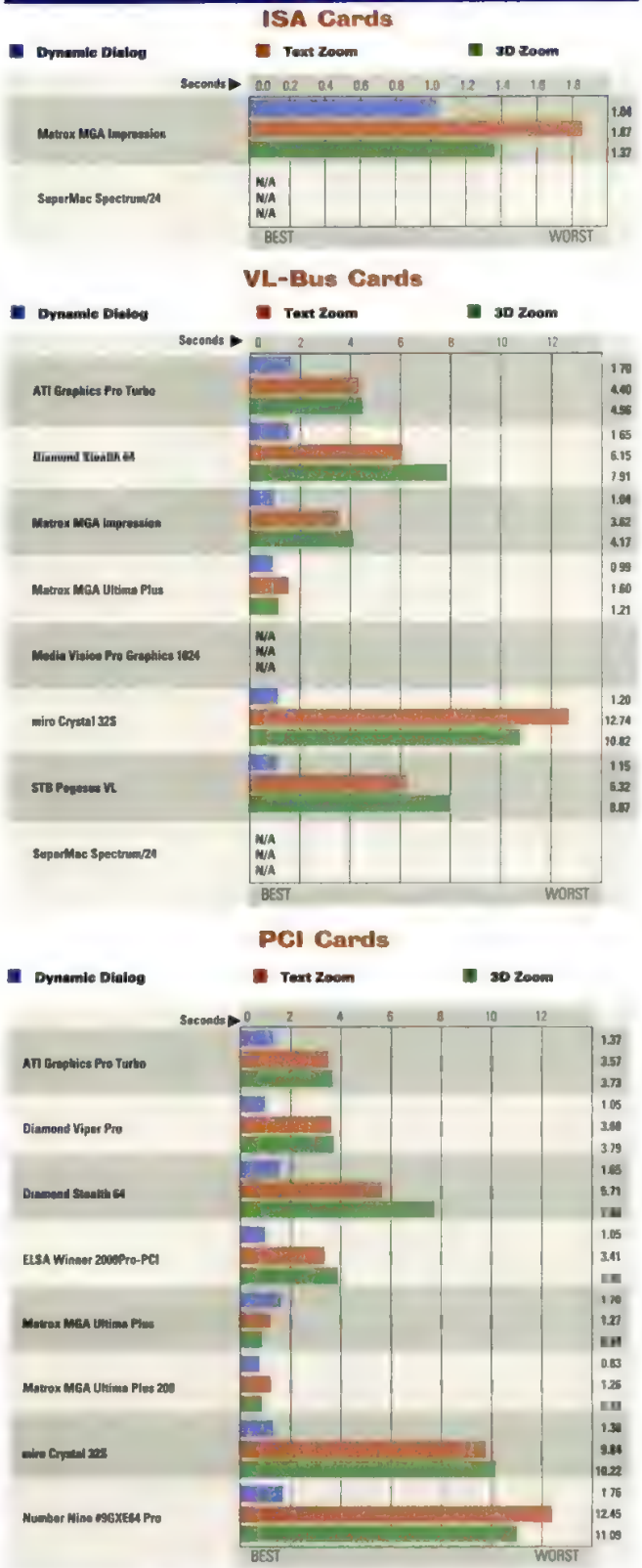
Our **Vector Graphics** test uses CorelDRAW, Version 4.0, to measure vector graphics performance. We perform a file-open routine using a complex test file, measuring the time it takes to draw to the screen. The file contains hundreds of 24-bit gradations and over 750 graphical draw elements using complex clipping paths. This test exploits both common and esoteric Windows GDI calls and exercises the graphics processor's ability to render vector graphics such as polygons, line draws, and area fills. We run the test three times and report the average timing for each product.

Our **Raster Graphics** test uses Adobe Photoshop for Windows, Version 2.51, to perform bit-block transfers in our 16.5MB test file. This 32-bit TIFF file contains an 8-bit alpha channel that resides above the 24-bit RGB channels. We measure the time required to rotate our test image 153 degrees counterclockwise and to perform a zoom operation. Because alpha channel tags are now supported in the TIFF 6 specification, we evaluate the impact the alpha channel has on drivers that use pixel-packing schemes in 32-bit data modes and tested the performance impact at 24-bit modes.

DOS VIDEO

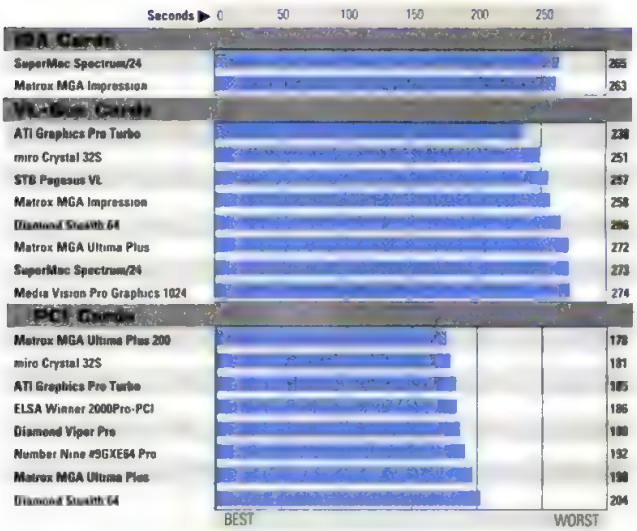


AUTOCAD

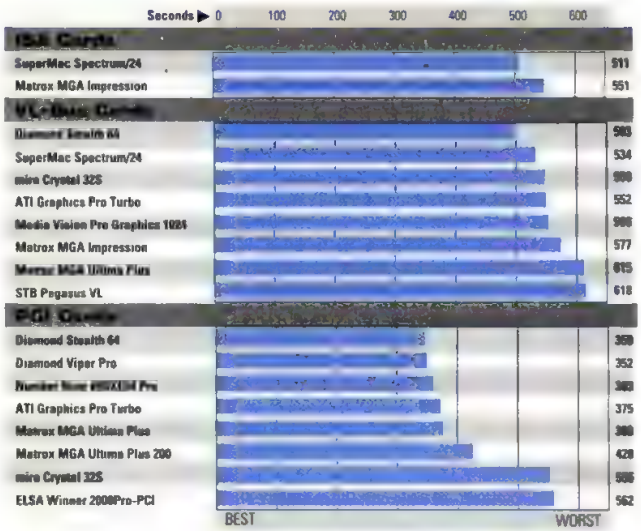


N/A—Not applicable: This vendor did not supply AutoCAD drivers.

RASTER GRAPHICS



VECTOR GRAPHICS



PC Labs' 50-page testing script also included a set of Mainstream Usability tests (not charted here; for more information, see the Suitability to Task key and ratings). These tests involve simultaneously running several Windows graphics and business applications and a DOS application running in a DOS window. This environment reduces the amount of available Windows resources to less than 26 percent. Next, we force palette changes by switching from one application to another, each of which has a different color palette or color mode loaded, and we look for remnant pixels left on-screen and for other anomalies.

What the Numbers Mean

The test scores cannot be directly compared across the board because of the two different platforms we used to accommodate each bus type. We expect a greater performance spread to occur when operating systems and applications are optimized for the Pentium processor. We found that performance was also tied to the speed at which the processor was running. Additional tests on DX4 systems produced higher scores than any generated on our primary test-beds. We expected such performance variations, along with the variations caused by differences in bus type (see the sidebar "Bus Effects: New Paths to Your CPU").

Overall, the five Matrox boards best handled our rigorous tests. Only on the DOS video tests did their performance fall short of their competitors'. Keep in mind that the margin of error on Winstone and WinBench tests is roughly 3 percent. Thus, many scores that appear close could almost be considered tied.

The top PCI boards—the Diamond Viper Pro, ATI Graphics Pro Turbo, MGA Ultima Plus 200, MGA Ultima Plus, and Diamond Stealth 64—all scored within 5 percent of one another on our Winstone test. Among the VL-Bus units, the ATI Graphics Pro Turbo, MGA Impression, and MGA Ultima Plus tied for the top spot on our Winstone test.

We used the AutoCAD for DOS drivers that shipped with each board to perform our AutoCAD tests. If no AutoCAD drivers were supplied, the board received an N/A for our tests. The units from Matrox—the only vendor with 3-D–zoom coordinate logic built into its accelerator chip—sometimes performed ten times as fast as the slowest boards on the AutoCAD 3-D Zoom test.

Most boards with the same graphics chip achieved similar scores on our Graphics WinMark tests, and likewise on our Winstone test. The variations we found on the Raster and Vector Graphics applications tests can generally be attributed to the differences among driver optimizations. The noticeable exception to this rule was the Diamond Stealth 64, one of three products using the S3 Vision964 processor. Its test results were consistently above those of the other products using the same processor. According to Diamond, this is due to a combination of a highly optimized board layout and complementary driver optimization techniques, which permit running the S3 Vision964 chip 10 percent faster than its rated 60-MHz specification.

The 64-bit chips, most widely represented on the PCI boards, showed significant increases in processing speed at the high color depths we used in our testing. The miro Computer Products boards, which use the 32-bit S3 928 chip, could not outperform any of the 64-bit entries in WinBench testing, despite featuring excellent drivers that excelled on other tests.

ATI offers switchable data-handling modes for 24-bit color—24-bit and 32-bit. Traditionally, the red, green, and blue (RGB) channels, each occupying 8 bits, combine to make up 24-bit color. This amount of data provides the information to achieve up to 16.7 million colors. With each processing cycle, a set of RGB data is sent to the digital-to-analog converter (DAC). With 32 bits of space available to transport data to the DAC, the extra 8 bits is used to start sending the next portion of the RGB set. Cycle one looks like RGBR, cycle two looks like GBRG, and cycle three looks like BRGB. At the end of three cycles an additional set of RGB data has been sent to the DAC, which speeds up graphics performance. This approach is called packing pixels. The Diamond Viper Pro uses a similar approach and Matrox plans to introduce a packed pixel optimization on its boards as well.

ATI was the only vendor whose boards received higher Graphics WinMark scores with the 32-bit mode enabled because they use the packed-pixel technique. This technique cannot work, however, when the extra 8 bits are occupied with an alpha channel, which is commonly the case with high-end graphics. The alpha channel can contain additional information about the image file such as masked selections, or can describe a transparency layer.

—Analysis written by Jeff Mace

mance. These boards may not be the fastest of the lot, but they performed quite well on our tests, consistently finishing near the top of the pack. The software adds a lot to the boards' usability; ATI has provided the user with a set of tools that offer genuine productivity enhancements that meet the needs of the graphics-intensive user. With a bit of seasoning, the Graphics Pro Turbo boards could be first-class products.

▶ **ATI Graphics Pro Turbo.** List price: *$699.* ATI Technologies Inc., *33 Commerce Valley Dr. East, Thornhill, Ontario L3T 7N6 Canada; 905-882-2600, fax, 905-882-2620.*

Circle 500 on reader service card

Diamond Computer Systems Inc.

• Diamond Stealth 64

BY JAN OZER

With its Diamond Stealth 64 graphics boards, mass-market leader Diamond Computer Systems sought to ride S3's new 64-bit chip to the top of the high-performance graphics market. However, while Diamond coaxed the most from the S3 Vision964 chip and the Stealth excelled on vector-intensive tests, the board fell just short in pure raster performance. The Stealth's first-generation software also lacks the breadth, depth, and stability of more mature offerings. However, aggressively priced at $599 for both VL-Bus and PCI versions ($399 for 2MB versions), the Stealth fires a loud shot at high-end market players Matrox and Number Nine.

SUITABILITY TO TASK Diamond Stealth 64	
CAD	GOOD
Raster graphics	GOOD
Vector graphics	GOOD
Mainstream usability	GOOD

Both Stealth boards led the pack on the Vector Graphics test, but they lost ground on the Raster Graphics test. On the latter test, which involves rotating and repainting a 16MB image, the Stealth PCI board finished last, the only time it was outperformed by the other Vision964-equipped boards. The Stealth VL-Bus board placed fifth out of eight.

However, these numbers aren't as bad as they look because the difference in score between the fastest and slowest boards was fairly small. On the Graphics WinMark tests, which measure overall graphics performance, the Stealth VL-Bus placed second, falling short of the leader by about one percentage point.

Diamond Stealth 64 (PCI)

The PCI version placed third, just under four percentage points behind the leader. On the Winstone tests, which measures general Windows performance, the Stealth PCI board placed fifth.

DOS performance was equally impressive, with the Stealth VL-Bus winning overall honors and the PCI version placing second. Both Stealth boards were average performers on our AutoCAD test suite, placing at or below the middle of the pack on most tests.

THE SOFTWARE STORY

Unfortunately, Diamond's software drivers and utilities can't compete in terms of features and stability with those of the other vendors in this roundup. Diamond's InControl Tools, which control Windows operation, provide an adequate feature set, including monitor presets, a virtual desktop with up to 2,048- by 1,536-pixel resolution with hotkey pan and zoom, color calibration, and gamma control. However, InControl's operation was confusing and occasionally erratic. To complicate matters further, there is no on-line help. The Stealth's user manual did nothing to provide any insight, either: The InControl application is simply not documented.

Furthermore, the first time we tried using the hotkeys, they didn't work. When we tried later on the same machine, they functioned normally. Diamond recommended that we disable InControl, which is necessary for performing hotkey operations, when running Windows benchmark tests.

Overall, Stealth's advanced software functions feel more like placeholders for anticipated review checklists than well-conceived features designed to assist users in real applications. Also, Diamond did not implement several key features such as on-the-fly mode switching while remaining in Microsoft Windows.

Finally, while operation was stable during most testing, both Stealth boards crashed during our mainstream Windows applications testing. None of these results are particularly surprising given the relative age of Diamond's software and especially given the Stealth's extremely short design cycle. While we don't endorse the video board market's "driver du jour" philosophy, we can't ignore its existence. However, it is safe to say that by the time you read this article, the Stealth's software should be much more stable.

▶ **Diamond Stealth 64.** List price: *$599.* Diamond Computer Systems Inc., *1130 E. Arques Ave., Sunnyvale, CA 94086; 408-736-2000; fax, 408-730-5750.*

Circle 501 on reader service card

Diamond Computer Systems Inc.

• Diamond Viper Pro

BY JAN OZER

If you're looking for a fast, affordable graphics accelerator with a clear upgrade path to multimedia, Diamond Computer Systems' $699 Diamond Viper Pro is a great choice. However, for high-end graphics applications, the Viper Pro is a work in progress that lacks most of the software functionality provided by similarly priced boards, which also have equal or better hardware performance.

The Viper Pro is the only reviewed product using Weitek's P9100 graphics accelerator chip. In addition to a full complement of raster and graphics functions such as hardware cursor, BitBlts, and line and vector draws, the P9100 offers 64-bit data paths to both the RAMDAC and the 4MB of VRAM. Combined with IBM's 200-MHz RGB525 Palette DAC, the Viper Pro offers a *packed-pixel* mode, which enables 1,280-by-1,024 resolution at 24-bit color in only 4MB of VRAM at a refresh rate of 75 Hz.

SUITABILITY TO TASK Diamond Viper Pro	
CAD	GOOD
Raster graphics	FAIR
Vector graphics	FAIR
Mainstream usability	FAIR

Diamond will ultimately ship the Viper Pro in both VL-Bus and PCI configurations, but only the PCI version was ready for our review. The Viper Pro topped the PCI charts on the Winstone 94 test, which indicates exceptional performance in exe-

cuting mainstream Windows applications. Graphics performance was more modest, with a Graphics WinMark score landing in the middle of the PCI pack. This score is somewhat in contrast with the Viper Pro's performance on our Vector Graphics test. The Viper Pro finished second only to the S3-based Diamond Stealth 64.

Unfortunately, Diamond doesn't complement this high-performance hardware with even minimum software functionality, such as a virtual desktop or color calibration. Superior software, such as that offered by ATI and Matrox, also offer gamma correction, as well as on-the-fly mode switching and color dithering, which are essential for intensive graphics use.

Diamond Viper Pro

The lack of these features accounted for the Viper Pro's modest scores in raster and vector graphics performance. Diamond promises to remedy these deficiencies by porting the Stealth's software suite to the Viper Pro by early summer. However, the port may not be as easy and painless as Diamond expects. While the Viper Pro worked through the Graphics WinMark and Winstone testing without problem, its current drivers failed our mainstream usability tasks by repeatedly crashing.

Diamond provides AutoCAD functionality through the Vibrant Graphics Soft Engine driver, which offers protected-mode ADI and display-list drivers. However, the driver delivered only middle-of-the-pack performance on our benchmark and performance tests. In DOS performance, the Viper Pro was not among the top third of PCI boards we tested.

The Viper Pro's DOS-based monitor-selection and display-mode utility installed without a problem. The program has presets for most popular monitors, including the NEC 4FG used in our tests. The Viper Pro's Windows drivers install through a separate program launched from Windows via the File/Run command. However, the Windows configuration program doesn't read the monitor type from the DOS utility program; you have to reselect it.

The Viper Pro is one of the first products supporting the Weitek P9130 Video Power chip, an option that enhances motion video playback rates of up to 30 frames per second at resolutions of up to 1,280 by 1,024 pixels. The P9130 works with all leading compression formats including Intel's Indeo, Media Vision's Cap'n Crunch, SuperMac's Cinepak, motion JPEG, and MPEG. Also, the P9130 option adds only $100 to the basic Viper Pro price.

The Viper Pro allows you to run big screens at high color depths, while offering you a glimpse at the future of multimedia video architectures. Unfortunately, from a software perspective the product is a work in progress.

▶ **Diamond Viper Pro.** List price: *$699.* Diamond Computer Systems, *1130 E. Arques Ave., Sunnyvale, CA 94086; 408-736-2000; fax, 408-730-5750.*

Circle 502 on reader service card

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CIRCLE 362 ON READER SERVICE CARD

ELSA Inc.

• ELSA Winner 2000Pro-PCI

BY JONATHAN HILL

The $949 ELSA Winner 2000Pro-PCI is based on the S3 Vision964 64-bit graphics accelerator. Although several boards in this roundup demonstrate the raw power of this new chip, the Winner 2000Pro's performance was less than stellar, and its arcane installation procedures are guaranteed to turn off all but the most hardened support personnel. To be fair, CAD power users will appreciate ELSA's optional CAD-Edition display-list processor, and the board does boast a decent set of Microsoft Windows features and top-quality hardware components.

SUITABILITY TO TASK	ELSA Winner 2000Pro-PCI
CAD	GOOD
Raster graphics	GOOD
Vector graphics	FAIR
Mainstream usability	GOOD

ELSA is a German company whose products are sold only through CAD dealers and resellers in this country. The DOS-based installation program allows you to proceed in German or English, but it seems obvious that the manual was written in German and then (loosely) translated into English. Translation errors make a complicated installation procedure difficult to follow.

After you have fought your way through the DOS installation program or decided to live with the defaults, you can proceed to the Windows driver setup. ELSA is the only vendor in this roundup to rely on Windows' own setup program. This may seem like a minor inconvenience, but if you are changing resolutions from the default 640-by-480 VGA mode, you will need to dig up your old Windows disks to install the appropriate screen fonts and backgrounds and to verify the location of the OEMSETUP.INF file.

ELSA Winner 2000Pro-PCI

After installing the drivers and booting Windows, ELSA's WINman utility starts up automatically. WINman is fairly well designed and provides access to multiple display resolutions, color depths from 8 bits per pixel to 24-bit color at 32 bits per pixel, vertical refresh rates of up to 100 Hz, and virtual-display capabilities.

ELSA offers two versions of its CAD driver/display-list processor (DLP). The basic version includes ELSAadi, an ADI driver that implements bird's-eye view, magnifying glass, worldview, and dynamic pans and zooms, and a graphical menu system called ELSAicon. The Optional CAD-Edition ($269) contains enhancements to ELSAicon that allow the user to generate customized menus. It also includes a drawing-management utility, ELSAview. Both versions of the software contain useful, productivity-enhancing fea-

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▶ SUMMARY OF FEATURES

Graphics Accelerator Boards

PC MAGAZINE PC MAGAZINE

Products listed in review order ■ = YES □ = NO	ATI Graphics Pro Turbo	ATI Graphics Pro Turbo	Diamond Stealth 64	Diamond Stealth 64	Diamond Viper Pro	ELSA Winner 2000Pro-PCI	Matrox MGA Impression	Matrox MGA Impression
List price	$699	$899	$599	$599	$699	$949	$999	$1,199
Bus type	VL-Bus	PCI	VL-Bus	PCI	PCI	PCI	ISA	VL-Bus
Graphics accelerator chip	ATI mach 64	ATI mach 64	S3 Vision964	S3 Vision964	Weitek P9100	S3 Vision964	MGA 64	MGA 64
VGA BIOS manufacturer	ATI	ATI	Diamond	Diamond	Diamond	ELSA	LSI Logic Corp.	LSI Logic Corp.
VGA pass-through connector	■	■	■	■	□	■	■	■
Hardware cursor	■	■	■	■	■	■	■	■
Display Characteristics								
Maximum noninterlaced graphics resolution	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,280 x 1,024	1,600 x 1,200	1,600 x 1,200	1,600 x 1,200	1,600 x 1,200
Maximum number of colors (noninterlaced):								
At 1,280 x 1,024	16.7 million	16.7 million	65,536	65,536	16.7 million	65,536	N/A	N/A
At 1,024 x 768	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
At 800 x 600 (Super VGA)	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
VESA support	■	■	■	■	■	■	■	■
Display memory (tested unit)	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	3MB VRAM	3MB VRAM, 2MB DRAM
Maximum installable memory	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	3MB VRAM, 2MB DRAM	3MB VRAM, 2MB DRAM
RAMDAC	ATI 68860	ATI 68860	Brooktree 485	Brooktree 485	IBM RGB525	Texas Instruments 3020	Brooktree 485	Brooktree 485
Preset refresh rates for specific monitor models	■	■	■	■	■	■	■	■
Custom refresh-rate settings	■	■	■	■	■	■	■	■
Software Drivers								
8514/A	□	□	□	□	□	□	□	□
OS/2 2.1	■	■	Optional	Optional	Optional	■	Optional	Optional
AutoCAD	■	■	■	■	■	■	■	■
Bird's-eye zoom	■	■	■	■	■	■	■	■
Display-list processor or driver	■	■	■	■	■	■	■	■
Protected-mode ADI	■	■	■	■	■	■	■	■
Text window	■	■	■	■	■	□	■	■
Graphics Processor Chip Features								
Area fills	■	■	■	■	■	■	■	■
BitBlts (bit-block transfers)	■	■	■	■	■	■	■	■
Bitmap caching	■	■	■	■	■	□	■	■
Font caching	■	■	■	■	■	□	■	■
Graphical draw primitives	■	■	■	■	■	■	■	■
Line/vector draws	■	■	■	■	■	■	■	■
Pattern copies	■	■	■	■	■	■	■	■
Pattern fills	■	■	■	■	■	■	■	■
Polygon fills	■	■	■	■	■	■	■	■
Microsoft Windows Utilities								
Color calibration	■	■	■	■	□	□	■	■
Gamma correction	■	■	■	■	□	□	■	■
Handles resolution switching	■	■	■	■	■	■	■	■
Pan	■	■	■	■	□	■	■	■
Virtual desktop	■	■	■	■	□	■	■	■
Maximum resolution	2,048 x 2,048	2,048 x 2,048	2,048 x 1,536	2,048 x 1,536	N/A	2,048 x 2,036	1,600 x 1,200	1,600 x 1,200
Zoom	■	■	■	■	□	□	■	■
Customer Support								
Toll-free technical support	□	□	□	□	□	■	□	□
Technical support hours (eastern time)	9:00–7:00 M–F	9:00–7:00 M–F	9:00 A.M.–10:00 P.M. M–F; 11:00–7:00 Sat.	9:00 A.M.–10:00 P.M. M–F; 11:00–7:00 Sat.	9:00 A.M.–10:00 P.M. M–F; 11:00–7:00 Sat.	11:00–8:00 M–F	8:00–6:00 M–F	8:00–6:00 M–F
Warranty	5 years	5 years	5 years	5 years	5 years	3 years	2 years	2 years

N/A—Not applicable: The product does not have this feature.

ENDS

PC MAGAZINE EDITORS' CHOICE	PC MAGAZINE EDITORS' CHOICE	PC MAGAZINE EDITORS' CHOICE							
Matrox MGA Ultima Plus	**Matrox MGA Ultima Plus**	**Matrox MGA Ultima Plus 200**	**Media Vision Pro Graphics 1024**	**miro Crystal 32S**	**miro Crystal 32S**	**Number Nine #9GXE64 Pro**	**STB Pegasus VL**	**SuperMac Spectrum/24**	**SuperMac Spectrum/24**
$799	$799	$999	$449	$899	$899	$749	$849	$799	$799
VL-Bus	PCI	PCI	VL-Bus	VL-Bus	PCI	PCI	VL-Bus	ISA	VL-Bus
MGA 64	MGA 64	MGA 64	MVV452	S3 Vision928	S3 Vision928	S3 Vision964	S3 928	SuperMac SQD	SuperMac SQD
LSI Logic Corp	LSI Logic Corp.	LSI Logic Corp.	Cirrus	S3	S3	Number Nine	STB	Cirrus Logic	Cirrus Logic
■	■	■	□	□	□	■	■	■	■
■	■	■	■	■	■	■	■	□	□
1,600 x 1,200	1,600 x 1,200	1,600 x 1,200	1,024 x 768	1,408 x 1,024	1,408 x 1,024	1,600 x 1,200	1,600 x 1,200	1,152 x 910	1,152 x 910
65,536	65,536	65,536	N/A	65,536	65,536	65,536	64,000	N/A	N/A
16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
■	■	■	■	■	□	■	■	□	□
4MB VRAM	4MB VRAM	4MB VRAM	2.25MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	3MB VRAM	3MB VRAM
4MB VRAM	4MB VRAM	4MB VRAM	2.25MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	3MB VRAM	3MB VRAM
Texas Instruments 3020	Texas Instruments 3020	Texas Instruments 3020	Media Vision MVV462	Brooktree 485	Brooktree 485	Texas Instruments 3025	Brooktree 485	Analog Devices 471	Analog Devices 471
■	■	■	■	■	■	■	□	■	■
■	■	■	■	■	■	■	■	■	■
□	□	□	□	□	□	□	□	□	□
Optional	Optional	Optional	□	Optional	Optional	Optional	■	□	□
■	■	■	■	■	■	■	■	□	□
■	■	■	□	■	■	■	□	N/A	N/A
■	■	■	□	■	■	■	■	N/A	N/A
■	■	■	■	■	■	■	■	N/A	N/A
■	■	■	□	■	■	□	■	N/A	N/A
■	■	■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■	■	■
■	■	■	■	■	■	□	□	□	□
■	■	■	■	■	■	□	■	□	□
■	■	■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■	■	■
■	■	■	■	■	■	■	■	■	■
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■	■	■	□	■	■	■	□	■	■
■	■	■	□	■	■	■	□	■	■
■	■	■	■	■	■	■	■	■	■
■	■	■	□	■	■	■	□	□	□
■	■	■	□	■	■	■	□	■	■
1,600 x 1,200	1,600 x 1,200	1,600 x 1,200	N/A	2,048 x 1,024	2,048 x 1,024	2,048 x 2,048	N/A	1,024 x 768	1,024 x 768
■	■	■	□	■	■	■	□	□	□
□	□	□	■	■	■	□	■	■	■
8:00–6:00 M–F	8:00–6:00 M–F	8:00–6:00 M–F	11:00–8:00 M–F	1:00–10:00 P.M. M–F	1:00–10:00 P.M. M–F	8:00–6:00 M–F	7:00–5:00 M–F	9:00–8:00 M–W, F; 9:00–7:00 Th	9:00–8:00 M–W, F; 9:00–7:00 Th
2 years	2 years	2 years	3 years	2 years	2 years	5 years	Lifetime	5 years	5 years

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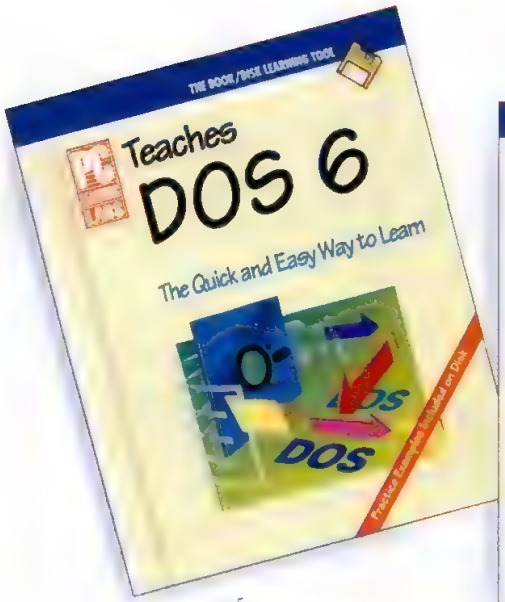

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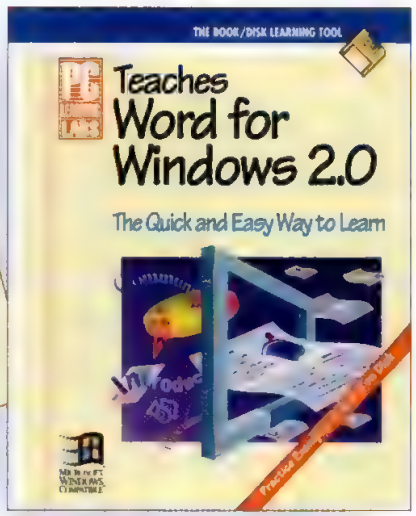

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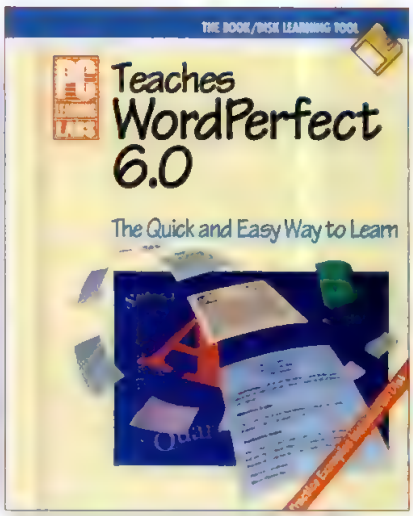

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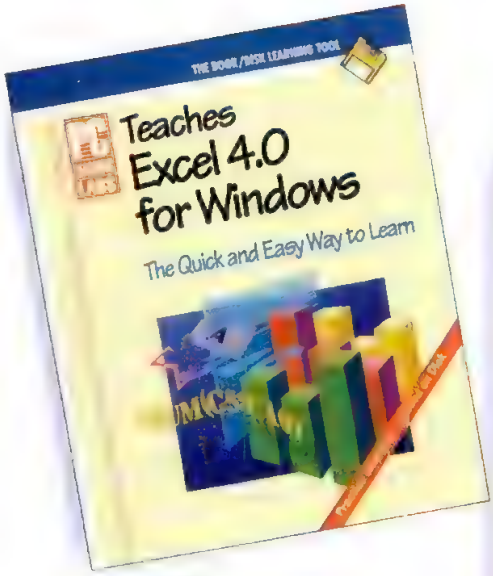

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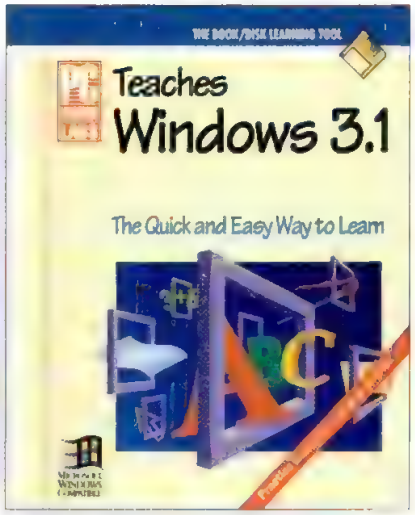

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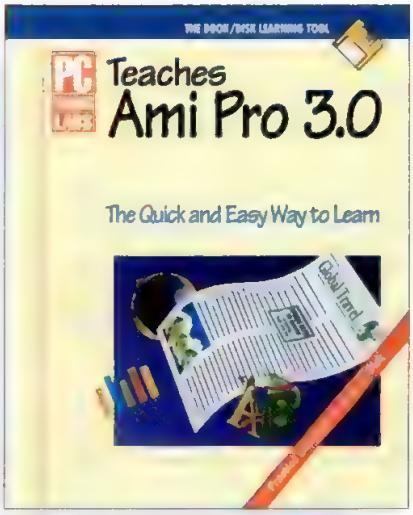

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—Hugh Anderson, *The Gazette*, reviewing *PC Learning Labs Teaches DOS*

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tures, but the overall design suffers from some of the same problems as the installation software.

The Winner 2000Pro demonstrated lackluster performance on our benchmark and performance tests when compared with its competitors in this roundup. Its Graphics WinMark score was a full 9 million pixels per second slower than the fastest Vision964-based board. The card's performance on our Winstone 94 test was worse than that of five of the eight VL-Bus cards. The Winner 2000Pro fared poorly on our Vector Graphics test, finishing last among the PCI cards. The only bright spot was the unit's stellar performance on the Raster Graphics test, which the Winner 2000Pro managed to complete in 186 seconds, placing it within 5 percentage points of the top-ranked MGA Ultima Plus 200.

MGA Impression (ISA)

The Winner 2000Pro's Vision964 accelerator chip was paired with an excellent 170-MHz Texas Instruments true-color DAC, allowing the board to support very high refresh rates with good color saturation. ELSA's support for a wide variety of CAD software is also noteworthy. These features, however, are overshadowed by an unfriendly installation procedure and mediocre performance. One can only hope that revisions in the software will improve these aspects of the package to allow the board's hardware components to shine.

▶ **ELSA Winner 2000Pro-PCI.** List price: *$949.* ELSA Inc., *400 Oyster Point Blvd., #109, South San Francisco, CA 94080; 800-272-3572, 415-615-7799; fax, 415-588-0113.*

Circle 503 on reader service card

Matrox Graphics Inc.

PC MAGAZINE EDITORS' CHOICE

Matrox MGA Impression
Matrox MGA Ultima Plus

BY JONATHAN HILL

All five boards submitted by Matrox Graphics for this review are based on the company's proprietary MGA 64 series of accelerator chips. The result is an array of standout products that share a common interface and excellent performance characteristics.

Matrox divides its product offerings into two main groups: the MGA Impression series and the MGA Ultima Plus series. We reviewed two MGA Impression cards (ISA and VL-Bus versions, $999 each; 2MB DRAM add-on, $200) along with three MGA Ultima Plus offerings: the PCI- and VL-Bus–based MGA Ultima Plus cards ($549 each; 2MB VRAM add-on, $250) and the PCI-based Ultima Plus 200 ($999).

The MGA Impression series is targeted squarely at the 3-D CAD and rendering markets. When used in combination with Matrox's DynaView for AutoCAD driver, the MGA Impression boards' ability to process 3-D Gouraud shading commands in real time provides capabilities generally associated with RISC-based 3-D workstations.

Rendering a wireframe model in AutoCAD or 3D Studio is nearly instantaneous; once rendered, you can "walk" smoothly through the rendered image without time lags. Also, the Bird's Eye View and Spy Glass View utilities function perfectly and are impressive in concert with the MGA Impression's 3-D shading support. Other features include a well-designed virtual desktop, Pixeltouch for hardware pans and zooms, and VideoView, which allows you to zoom 24-bit Video for Windows playback dynamically to full-screen.

SUITABILITY TO TASK Matrox MGA Impression	
CAD	EXCELLENT
Raster graphics	EXCELLENT
Vector graphics	GOOD
Mainstream usability	EXCELLENT

A STRONG IMPRESSION

MGA Impression cards support the use of an optional DRAM module, which functions as a z-buffer and improves 24-bit color performance by increasing the memory available for off-screen bitmap caching. The VL-Bus version we tested came fitted with 2MB of DRAM in addition to its main memory of 3MB of VRAM. Real-time 3-D Gouraud shading is supported at resolutions of up to 1,280 by 1,024 pixels in 8-bit color in this configuration. The ISA version we tested did not include the optional DRAM ($200); its accelerated 3-D shading support is limited to a maximum resolution of 800 by 600 pixels, though it can support 24-bit color.

SUITABILITY TO TASK Matrox MGA Ultima Plus	
CAD	EXCELLENT
Raster graphics	EXCELLENT
Vector graphics	GOOD
Mainstream usability	EXCELLENT

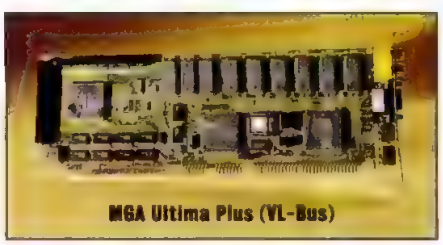
The MGA Ultima Plus series is designed for 2-D CAD and high-resolution 24-bit Windows applications. Whereas the MGA Impression cards offer integrated 3-D acceleration, the MGA Ultima Plus cards sacrifice this feature in favor of top-notch performance at very high resolutions and refresh rates.

Both versions of the MGA Ultima Plus came with 4MB of VRAM memory and a 175-MHz 64-bit DAC to support resolutions up to 1,600 by 1,200 pixels in 16-bit color with a vertical refresh rate of 66 Hz. The MGA Ultima Plus 200's 200-MHz DAC extends this range to enable a vertical refresh rate of 76 Hz at the same resolution and color depth (a 100-Hz refresh rate can be achieved at 1,280-by-1,024 resolution).

The difference in resolution is dramatic on the 20-inch or larger monitors used in dual-page desktop publishing and image-editing applications. Also, the higher refresh rates significantly reduce the eyestrain that can result from staring at computer screens for prolonged periods of time.

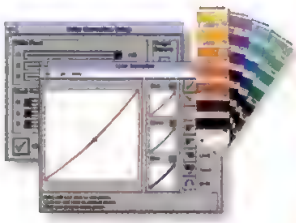
IN THE DRIVER'S SEAT

Matrox's stable and extremely fast Windows drivers are first-rate. The two PCI-based offerings, the MGA Ultima Plus and Ultima Plus 200, performed significantly faster than all of the other boards in this roundup on WinBench 4.0 and tied for first place with the Diamond Viper Pro and ATI Graphics Pro Turbo on Winstone 94, Version 1.0. The VL-


MGA Ultima Plus (VL-Bus)

Lynne - Graphic Designer :

"Color. I need rich beautiful colors in fine detail. The colors on the screen must match the printer. *And speed.* When I make a change, I want it on the screen instantly. Nothing less will do. "ATI's GRAPHICS PRO TURBO gives me the *best image quality* in 16.7 million vivid colors at high resolution 1280x1024 graphics and with superior speed and an easy-to-use color calibration feature."



Precise color calibration

Doug - Power User :

"Only ATI's GRAPHICS PRO TURBO met MY spec! I wouldn't settle for less for my new Pentium computer. It is not just the *fastest Windows performer* overall: 42M Winmarks with 256 colors and 28M Winmarks in true color. It also comes *loaded with Windows features,* such as the ability to instantly switch color and resolution without leaving Windows, and FlexDesk+, an advanced software panel to control color, resolution, desktop and motion video acceleration. ATI's GRAPHICS PRO TURBO has a complete set of *drivers for all the other operating systems."*

Harry - Architect :

"Detail. My drawings and models have incredible detail. I need *resolution* so sharp, I could cut my finger on it. *Performance and color* are critical in both DOS and Windows. And, I want a graphics card that will *reduce eye strain.*

"ATI's GRAPHICS PRO TURBO gives fast true color at high resolutions under both DOS and Windows. It comes with fast and feature rich drivers for *my CAD applications.* After I'm done, I can unwind the day with an exciting game. Only *fast DOS performance* makes that possible."

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- **16.7M Colors at 1280x1024**
- **Enhanced Windows Utilities**

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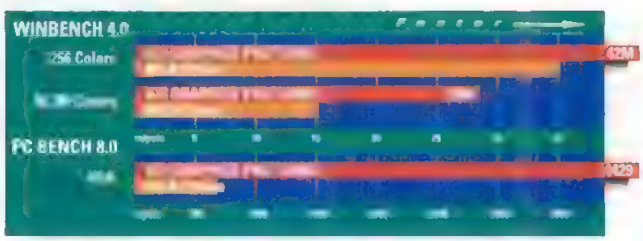
WINDOWS AND DOS PERFORMANCE*



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Bus–based MGA Impression and MGA Ultima Plus were also top-tier performers on both tests, though the ISA-based MGA Impression posted a higher Winstone score than either of them.

Matrox is one of the few vendors to offer on-the-fly resolution and color depth switching in Microsoft Windows. At the cost of a small drop in performance, the Modeswitch utility allows you to set up four hotkeys for switching between graphics modes without restarting Windows. Another unique feature is QCDP (Quality Color Dithering Process), a dithered 8- and 16-bit color driver that simulates 24-bit colors at resolutions up to 1,600 by 1,200 pixels. We were very impressed with this feature and the way it displays 24-bit images in only 256 colors.

Matrox provides its own CAD driver. DynaView transforms the standard AutoCAD interface: Every window is sizable and movable in Matrox's implementation. DynaView's performance on our AutoCAD tests was excellent in light of the fact that the automated tests do not invoke several of the driver's features, including one-step dynamic pans and zooms and 3-D rendering. The board ships with drivers for AutoCAD for Windows. CAD drivers for 3D Studio, MicroStation, OS/2, Windows NT, and Unix are available at no extra charge.

Overall, Matrox's MGA Impression and MGA Ultima Plus series form an impressive array and are clearly the best high-performance graphics accelerators on the market today. Future offerings incorporating the VESA Advanced Feature Connector (VAFC), which may be shipping by the time you read this, will work in concert with VAFC-equipped video-capture boards and peripherals for high-performance multimedia applications.

▶ **MGA Impression.** List price: *$999; 2MB DRAM add-on, $200.* **MGA Ultima Plus.** List price: *$549; 2MB VRAM add-on, $250.* **MGA Ultima Plus 200.** List price: *$999.* Matrox Graphics Inc., *1055 St. Regis Blvd., Dorval, Quebec H9P 2T4, Canada; 800-361-1408, 514-685-2630; fax 514-685-2853.*

Circle 504 on reader service card

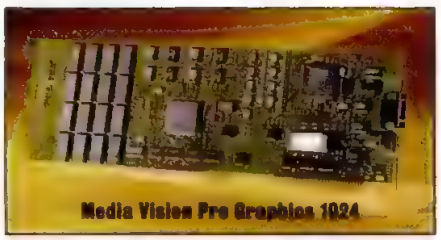
Media Vision

• Media Vision Pro Graphics 1024

BY JAMES KARNEY

Media Vision's latest entry into the high-performance graphics accelerator board market, the $449 Pro Graphics 1024, is notable for its innovative design. While it can produce high-resolution true-color displays, it lacks the software enhancements found in most of the other products in these reviews. This adapter is really geared for the mass market rather than the graphics professional.

The Pro Graphics 1024 VL-Bus-graphics card is based on Media Vision's proprietary chip set, which allows operation at 1,024-by-768 true-color resolution with only 2.25MB of VRAM, compared to the 4MB used by most of its competitors. The heart of the Pro Graphics card is Media Vision's Stingray24 chip set, which consists of the MVV452 graphics engine and the MVV462 DAC.


Media Vision Pro Graphics 1024

The MVV452 features a 72-bit internal architecture that supports three-way interleaved writes to VRAM memory. It also provides acceleration functions, VGA support, and a frame-buffer interface. The companion MVV462 DAC de-interleaves the VRAM, manages color lookup tables, and handles functions such as the hardware cursor.

The Pro Graphics 1024 fared very well among VL-Bus–based products on our 1,024-by-768 resolution Graphics WinMark tests, tying with the Diamond Stealth 64 for second place at a score of 16.9 million pixels per second, just behind the Matrox Ultima Plus at 17.1 million. The Pro Graphics 1024's Winstone rank was lower; the board finished in sixth place with a score of 49.8. The board finished last in our Raster Graphics tests under Adobe Photoshop, averaging 273.7 seconds. In our Vector Graphics tests under CorelDRAW, the Pro Graphics 1024 came in fifth of the eight boards we tested, averaging 556.3 seconds.

SUITABILITY TO TASK

Media Vision Pro Graphics 1024	
CAD	N/A
Raster graphics	FAIR
Vector graphics	FAIR
Mainstream usability	FAIR

N/A—Not applicable: The product did not come with AutoCAD drivers.

PAINFUL INSTALLATION

Installing the Pro Graphics 1024 was a bit of an adventure. While most of the three-quarter-length card's solder joints are smooth, several near the lower leading edge are quite sharp, and one of our lab technicians nicked a finger on a join.

Configuring the card for our NEC 4FG monitors was also a challenge. The board's setup program can be used to specify various monitors, including the 4FG. However, the program failed to work with two different pairs of PCs and monitors. We had to call technical support and obtain a walk-through of the custom settings needed to get the card running on our test bed.

On the plus side, however, the Pro Graphics did have an excellent utility for adjusting the card to sync with monitors at nonstandard settings. The routine made quick work of adapting to a 72-Hz refresh rate.

You can adjust the memory wait states on the card to improve compatibility. The Pro Graphics 1024 ships with three wait states enabled, but we were able to improve performance by adjusting the settings to a two-read and one-write wait state.

SOME SOFTWARE, FEW ENHANCEMENTS

While other vendors are providing on-the-fly mode switching, virtual desktops, special CAD drivers, and color calibration software with their high-performance cards, Media Vision offers only Kai's Power Tools from HSC Software. It's a third-party set of add-ons for bitmap graphics programs such as Fractal Design Painter and Adobe Photoshop.

The lack of a virtual desktop is due in part to the board's unique design: With 2.25MB of VRAM, a virtual desktop would be limited to 1,024 by 768 pixels as a standard resolution. But on the plus side, Media Vision does include an uninstall program for the Windows driver.

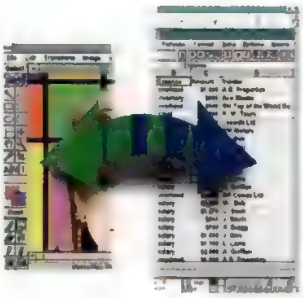
Media Vision's Pro Graphics 1024 features an interesting design, but it has not yet followed through with the drivers, software, and ease of installation required

Paul - Manager/Parent :

"I needed a performance boost for my PC. It took a long time for my charts and presentations to appear on the screen. The colors were flat and limited. And my son's games ran slowly. But, I wasn't ready to buy a whole new system.

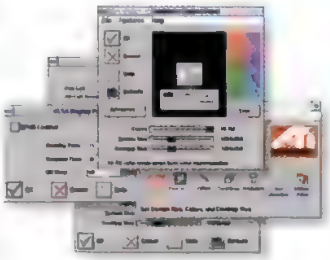
"Fortunately, I got great advice. For *just $299***, I got ATI's GRAPHICS XPRESSION. It revived my whole system.

"My friend had one. Windows snapped open quickly. Charts popped up on his screen. The *blazing speed,* 37M Winmarks*, was incredible. He said it offered *best value for price/performance.* And the improvement in color graphics and detail were most impressive.



WinSwitch changes color and resolution without leaving Windows

"Then, he showed me the features. WinSwitch allowed him to switch between true color mode or high resolution mode without exiting Windows. And ATI's FlexDesk+ software gave him *total control* over color, desktop size, resolution and even motion video acceleration.



FlexDesk+ easy control of desktop settings

"Finally, he told me it was the only affordable 64-bit accelerator for my ISA system. I rushed out to buy one. *Installation was easy.* There were no switches to set and the software guided me through the installation process. And I was amazed, it even came with a complete set of drivers for Windows, Windows NT, OS/2, CAD and DOS.

"Best of all, my PC now runs much faster in Windows, DOS and games. I almost never see that Windows hour-glass. GRAPHICS XPRESSION. At only $299, it is still great advice."

"I got the advice I needed."

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Outperforms other accelerators in Windows and DOS

- Resolutions up to 1280x1024 non-interlaced
- Full acceleration in 256 to 16.7M colors
- Comes with enhanced driver support for Windows, OS/2 PM, Windows NT, CAD and DOS
- Up to 75Hz refresh rate
- Available for ISA, PCI or VESA Local Bus
- 2MB DRAM memory
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CIRCLE 178 ON READER SERVICE CARD

to succeed in today's high-performance 24-bit graphics accelerator market. If Media Vision uses the leverage of less memory on the card and in-house development of the Pro Graphics engine, the company may be able to keep the price low enough to appeal to the mass market—especially budget-conscious consumers. Perhaps Media Vision will keep working on software enhancements and develop a line of products that make full use of its engine.

▶ **Pro Graphics 1024.** List Price: *$449.* Media Vision Inc., *47300 Bayside Pkwy., Fremont, CA 94538; 800-684-6699, 510-770-8600; fax, 510-770-8648.*

Circle 505 on reader service card

miro Computer Products Inc.

• miro Crystal 32S

BY JEFF MACE

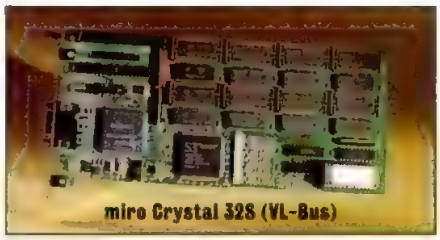
Neither of miro Computer Products' $899 entries in this roundup, the miro Crystal 32S VL-Bus version and miro Crystal 32S PCI version boards, will break any speed records. However, they do offer excellent compatibility in running mainstream Windows applications thanks to their stable drivers and some unique feature applets that extend productivity for the graphics professional.

The miro Crystals' performance, limited by the older 32-bit 928 graphics processor from S3, placed them just ahead of the slowest boards we tested under WinBench 4.0. However, the miro Crystal 32S PCI fared much better than its VL-Bus sibling overall, proving to be a strong DOS VGA performer. This board also surprised us by turning in a rather impressive score in our Photoshop image rotation test, finishing in second place.

SUITABILITY TO TASK	miro Crystal 32S
CAD	GOOD
Raster graphics	GOOD
Vector graphics	GOOD
Mainstream usability	GOOD

Both boards were easy to install, and we were helped along by instructions at the beginning of the manual. The same set of installation and driver disks is included for both bus architectures. However, both boards support only a limited number of screen refresh rates and do not have presets for popular monitors.

Central to the boards' Windows controls is Superscreen, with which you apply settings for resolution in standard (fixed-resolution) and virtual-desktop modes up to 1,408 by 1,024 pixels; you can set true-color modes up to 1,024 by 768 pixels. Both miro Crystal 32S boards come equipped with 4MB of VRAM, which enables a maximum color depth of 65K at 1,408-by-1,024 resolution. You can also specify hotkeys to allow switching from one mode or one feature to another.


miro Crystal 32S (VL-Bus)

Some of miro's add-on features for both boards are quite innovative. For example, miro's Twinface applet and driver allows you to double your maximum resolution to 2,816 by 1,024 pixels by placing a second miro card in the computer and outputting to a second monitor. You simply move the mouse across the desktop to move from one monitor to the other.

This feature is especially useful for desktop publishing applications such as QuarkXPress. For example, you can place your tool bars on one screen while using the primary screen for your design. For your second board, you can choose one of miro's less expensive models (which run at lower color depths). Miro also supplies an applet that provides a zoom window, analogous to AutoCAD's bird's-eye-view function, for a real-time zoom view at the cursor.

IT'S IN THE DRIVERS

The miro Crystal 32S boards boast strong AutoCAD drivers that support real-time 3-D animation. Unfortunately, unlike other performance tests by boards using the newer, faster processors, the results here were not dramatic.

The drivers in both boards proved their prowess throughout the testing process. Even with CorelDRAW, Adobe Photoshop, and Microsoft Word running in the background, we were able to open six DOS Windows while running small utility programs without any problems. This section of our tests proved fatal for several other products in the review.

Miro provides a multitude of drivers—at no extra charge—that enable the miro Crystal 32S boards to run under a variety of platforms, including Windows NT, OS/2, and NeXTStep. You can also use miro's BBS service to download the latest drivers.

Overall, the miro Crystal 32S VL-Bus and PCI boards are solid performers that warrant consideration if you need a stable accelerated graphics card and are willing to sacrifice some speed in favor of a more robust feature set. However, because these boards are priced the same as the newest and fastest boards in this roundup, it may be worthwhile to wait for miro's next generation of graphics cards, which should be available around the time you read this.

▶ **miro Crystal 32S.** List price: *$899.* miro Computer Products, *955 Commercial St., Palo Alto, CA 94303; 415-855-0940; fax, 415-855-9004.*

Circle 506 on reader service card

Number Nine Computer Corp.

• Number Nine #9GXE64 Pro

BY JONATHAN HILL

The Number Nine #9GXE64 Pro (base model with 2MB, $499; 4MB version, $749) distinguishes itself from the competition both by pairing the new S3 Vision-964 chip with a high-speed 64-bit digital-to-analog converter (DAC) from Texas Instruments and by offering an enviable array of productivity-enhancing features. The #9GXE64 is more than capable of supporting a wide range of high-performance applications, and expandability for future multimedia support is provided through the board's VAFC (VESA Advanced Feature Connector).

Number Nine #9GXE64 Pro

The TI 3025 true-color-palette DAC is rated to run at 175 MHz and gives the #9GXE64 the ability to support extremely high vertical refresh rates. When we ran the board at a 100-Hz vertical refresh

Color (kul'er) *n.* 1. A feature rarely found in low-cost inkjet or dot-matrix printers. *example:* the **TI microMarc™ Color** printer gives you vivid color for not much more than the cost of a black and white inkjet.

THE UNDER $400 PRINTER, REDEFINED.

If you thought you'd never see a high-quality color printer for a street price under $400,* wait'll you see the new TI microMarc Color, the inkjet printer that's as versatile as you are. At home, you can brighten up schoolwork, do newsletters – even print the rich, detailed colors of today's multimedia applications. At the office, you can add brilliant colors to proposals, charts and presentations. And if that's not enough, just compare the microMarc Color to our leading competitor, HP. From print quality all the way down to printer size, our advantages are obvious. In fact, we're so confident you'll like the new TI microMarc Color, we'll give you our 30-day satisfaction guarantee.** For more information or a dealer near you, call *1-800-TI TEXAS* (1-800-848-3927).

	TI microMarc Color	HP DeskJet™ 500C
Print Quality: Graphics	*300 dpi x 300 dpi*	*300 dpi x 300 dpi*
Resident Fonts	*600 dpi x 300 dpi*	*300 dpi x 300 dpi*
Speed: Color	*Up to 1 ppm*	*Up to .67 ppm*
Monochrome	*Up to 5 ppm*	*Up to 3 ppm*
Memory	*128K*	*48K*
Paper Tray	*120 sheets*	*100 sheets*
Standard Fonts	*5*	*3*
Weight	*11 lbs.*	*14 lbs.*

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TEXAS INSTRUMENTS

*Estimated dealer price. Dealer prices will vary. **Offer applies if returned in good condition. microMarc and "Extending Your Reach With Innovation" are trademarks of Texas Instruments. DeskJet is a trademark of Hewlett-Packard, Inc. Specifications in chart are based on information as of 4/94. © 1994 TI

CIRCLE 353 ON READER SERVICE CARD

rate of 1,024-by-768 in 24-bit color mode on a 20-inch monitor, it sustained a highly saturated, flicker-free display. But without Number Nine's DOS utility—supplied to PC Labs during testing—we could not get any refresh-rate features to work at all.

The #9GXE64's impressive array of Windows features includes a smooth installation program. When you restart Windows, the #9GXE64's HawkEye for Windows control panel is automatically loaded, and you'll find a Number Nine program group containing the full array of HawkEye features. The Status option, for example, provides a complete list of the current operating parameters, including the current display mode, driver version, and BIOS revision date.

SUITABILITY TO TASK	Number Nine #9GXE64 Pro
CAD	GOOD
Raster graphics	GOOD
Vector graphics	GOOD
Mainstream usability	GOOD

The Resolution Exchange option lets you select from an array of resolutions and color depths. The 4MB #9GXE64 that we tested supports 24-bit color to a maximum resolution of 1,152-by-864, 16-bit color to 1,280-by-1,024, and 8-bit color to 1,600-by-1,200. Number Nine's virtual desktop, also selectable via the Resolution Exchange option, is a particularly useful tool. Unlike most boards, which merely bump up the virtual screen to the next resolution, the #9GXE64 actually simulates a dual-page display, providing virtual resolutions in even multiples of the monitor resolution. Thus, if your screen displays at 1,024-by-768 resolution, the virtual resolutions available are 2,048-by-768 and 1,024-by-1,536.

Changing the resolution or color depth requires a Windows restart, but the Monitor Adjustment utility lets you modify the screen's refresh rates on the fly. To overcome potential misalignment caused by minor variations in your monitor's ability to sync properly with the new refresh rate, you can adjust and save the recentered screen by using the Display Position Adjustment utility.

Number Nine's CAD driver/display-list processor, PowerPac, is available in three configurations: Basic, Plus, and Professional. The Basic configuration that we tested contained a selectable 16- or 32-bit display-list processor and let us configure the screen resolution and customize buttons. It also supported single or dual screens. The Plus configuration adds pop-up bird's-eye windows, multiple-view support, and preconfigured pop-up icon menus. The Professional configuration adds user-configurable hierarchical icon menus and a configurable hotkey interface to the mix. Installation of PowerPac was smooth and trouble-free. PowerPac supports AutoCAD, Releases 10 through 12; AutoShade, Version 2.0; Autodesk 3D Studio, Versions 1.0 and 2.0; and MicroStation.

The #9GXE64's test performance placed it in the middle of the pack of boards based on the Vision964 chip, and thus in the top tier overall. The board's DOS video performance was exceptional, and its Winstone score of 17.9 was more than adequate. On our Raster Graphics test, the #9GXE64 was 8 percent behind the top-scoring MGA Matrox Ultima 200. Vector performance was also strong.

The #9GXE64's well-thought-out hardware and software feature set, combined with its exemplary test performance, earns it a hearty recommendation. Users requiring stable support for CAD, desktop publishing, document imaging, and multimedia applications won't be disappointed.

▶ **Number Nine #9GXE64 Pro.** List price: *2MB version, $499; 4MB version, $749.* Number Nine Computer Corp., *18 Hartwell Ave., Lexington, MA 02173, 800-438-6463, 617-674-0009; fax 617-674-2919.*

Circle 507 on reader service card

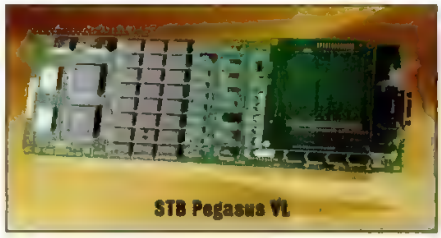
STB Systems Inc.

• STB Pegasus VL

BY JAN OZER

The STB Pegasus VL ($849) may be comparably priced with boards that are based on 64-bit silicon, but its 32-bit technology doesn't have the horsepower to compete with these products. The STB Pegasus performed at or near the bottom on virtually all of our tests, and its software suite is modest compared with those found in most of the other boards in this roundup. These factors make the STB Pegasus a poor choice for most graphics-intensive applications.

Built around S3's 32-bit 86C928 fixed-function accelerator chip, the STB Pegasus comes with 4MB of dual-ported VRAM. The 928 provides a hardware cursor and a range of raster and vector features that accelerate commonly used Windows operations such as BitBlts, pattern copies and fills, linear addressing, and point-to-point line drawing. But our tests revealed that the chip's 32-bit internal data path and data path to memory can't keep up with newer 64-bit chips.


STB Pegasus VL

The STB Pegasus's Winstone and Graphics WinMark scores were the lowest of all the VL-Bus boards tested. Discrete tests with Adobe Photoshop and CorelDRAW supported the WinMark showing—with the STB Pegasus placing last on two out of the three tests.

SUITABILITY TO TASK	STB Pegasus VL
CAD	GOOD
Raster graphics	POOR
Vector graphics	POOR
Mainstream usability	POOR

No card escaped our Windows usability and mainstream-application tests unscathed. The STB Pegasus, however, crashed earlier than most and was unable to open a DOS window with the test programs loaded. AutoCAD performance was slightly better. Pegasus ships with Panacea's TurboDLD *Classic* driver, which provides both protected-mode AutoCAD ADI applications and a display-list driver. While the STB Pegasus still lagged behind most of the other boards, at least it wasn't the slowest. Under DOS, the STB Pegasus placed fourth out of the eight VL-Bus graphics cards.

INSTALLATION ROUTINES

The board itself is solidly constructed and includes a VGA pass-through connector and a three-plug BNC adapter—a nice feature that reduces noise in the video signal. Installation is a multistep process. A simple DOS program selects video modes, monitor type, fonts, and color

Don't Wait for Windows

Stealth 64 Provides Non-Stop Performance in Windows, CAD and Games.

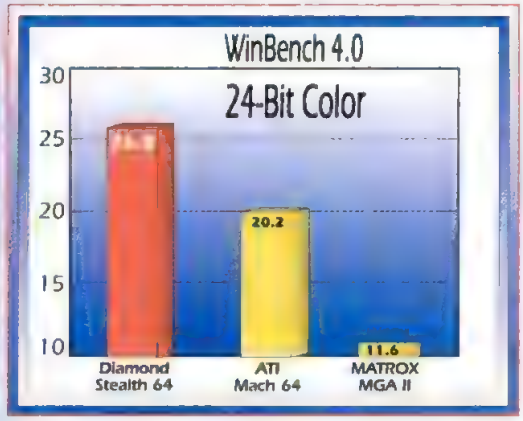
Non-Stop Graphics

Suffering from sluggish graphics performance? Tired of seeing the hourglass appear on your screen and seemingly never go away? Then get the fastest. The Stealth 64 graphics adapter provides screaming acceleration in the most demanding Windows applications without sacrificing performance in DOS and game environments.

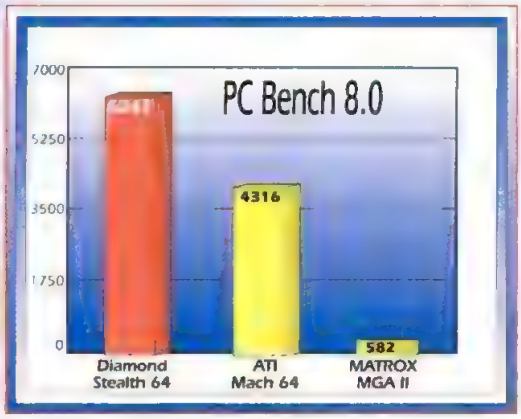
Powerful Features

- 64-bit graphics processor (S3 964)
- 43 million Winmarks in WinBench 4.0 (1024x768x256 colors on Intel P54C)
- 24-bit color at 1152x864 resolution
- Flicker-free, 120 Hz refresh rates
- 2MB VRAM and 4MB versions
- PCI and VESA bus compatible
- InControl Tools™ Windows productivity software included free

WINDOWS



GAMES & DOS



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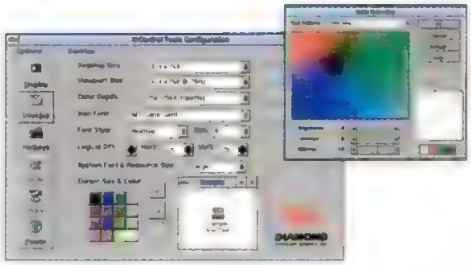

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depth. But the installation program does not offer presets for specific monitors—valuable features that save time during installation. During testing, we couldn't save our configuration to the on-board EEPROM (electrically erasable programmable ROM) and had to reconfigure each time we rebooted. STB Systems confirmed this and reported that it had fixed the problem.

After you set up the hardware, a separate program installs the Windows drivers. The program configures resolution, color depth, and font size. Unlike most other graphics cards, the STB Pegasus has a Windows installation program that retains only 8 custom settings out of more than 50 possible options. So, for example, if you don't select the 1,600-by-1,200 resolution, 256-color, large-font driver during setup, you can't select this configuration at a later time without separately installing the driver, which requires the original installation disks.

The STB Pegasus offers Windows resolutions of up to 1,600-by-1,200 in 8-bit color, which is higher than what several competing products offer. But the STB Pegasus doesn't offer the range of software features required for desktop publishing or similar graphics applications—lacking, for example, a virtual desktop with panning and zooming and some form of color calibration.

The STB Pegasus is a victim of the generation gap, at both the chip and software levels. Outperformed, outfeatured, and overpriced, it's difficult to see a niche that it fills. STB expects to announce two new boards with 64-bit graphics accelerators around the time you read this. We expect these boards to supersede the 86C928-based STB Pegasus.

▶ **STB Pegasus VL.** List price: *$849.* STB Systems Inc., *1651 North Glenville, #210, Richardson, TX 75081; 800-234-4334, 214-234-8750; fax, 214-234-1306.*

Circle 508 on reader service card

SuperMac Technology Inc.

• SuperMac Spectrum/24

unchanged since their introduction in April 1993, but their performance and features for serious image-editing tasks under Microsoft Windows are still among the best in this price range.

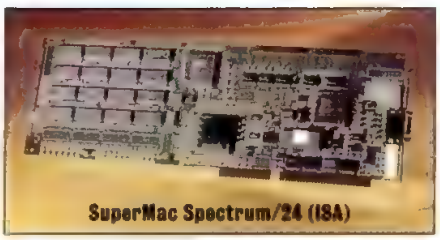
SUITABILITY TO TASK SuperMac Spectrum/24	
CAD	N/A
Raster graphics	GOOD
Vector graphics	GOOD
Mainstream usability	GOOD

N/A—Not applicable: The product did not come with AutoCAD drivers

Each card requires either a separate VGA card with a pass-through connector or SuperMac Technology's optional VGA daughtercard in order to display DOS text and graphics. In either case, be prepared to reserve two slots for your graphics peripherals: The daughtercard will block all but the smallest, thinnest cards from occupying an adjacent slot.

Once either card is installed, you are limited to working in 24-bit color under Windows. The Spectrum/24 cards neither support lower color depths nor provide AutoCAD drivers, and though they handle most mainstream Windows applications efficiently, they are certainly not speed demons.

At this point, you may be wondering exactly what unique features these boards do support. Both Spectrum/24 cards are designed for a single purpose: image editing for the photo-prepress and desktop publishing markets. They are among the best solutions available for working in applications such as Adobe Photoshop, Aldus PhotoStyler, and CorelDRAW.



SuperMac Spectrum/24 (ISA)

The installation program runs smoothly under Windows and, in fact, puts every other installation program in this roundup to shame. At every step, the Spectrum/24 cards provide options that let you view and modify the default settings. You can view the installation script before you execute it, and you can modify and test the suggested frame-buffer

After you install the board, you use the Resolution Picker feature either to select a display type or change the resolution or refresh rate of your existing installation. Both versions of the Spectrum/24 can drive an 1,152-by-910 display at a 75-Hz vertical refresh rate. SuperMac provides a prodigious list of displays, and you can create a custom monitor profile if your particular monitor is not on the list. In keeping with their emphasis on image-editing applications, the Spectrum/24 cards provide support for several unconventional resolutions—such as 832-by-624 and 1,152-by-870—to match the size and shape of your monitor or output device.

COLOR-SYNC

After saving your settings, you can use SuperMac's Monitor Calibration software. SuperMac sells the optional SuperMatch Display Calibrator Pro ($799), which is a hardware sensor that automatically analyzes and calibrates your graphics system. The color-calibration software, however, can be used without the accompanying hardware device to adjust for ambient light, set the gamma correction, and simulate various color temperatures for use under different lighting conditions.

The Spectrum/24 cards performed relatively poorly on our Windows-based tests. The cards are optimized for bitmapped manipulation functions utilized by image-editing software, and they cannot compete with cards that accelerate other functions such as the drawing of polygons and ellipses. Surprisingly enough, the VL-Bus version held its own on our Winstone test. Its vector performance under CorelDRAW was competitive with that of the newer graphics accelerator cards in this roundup, most of which fall short in providing the features necessary to support productive prepress work. □

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ESP $755

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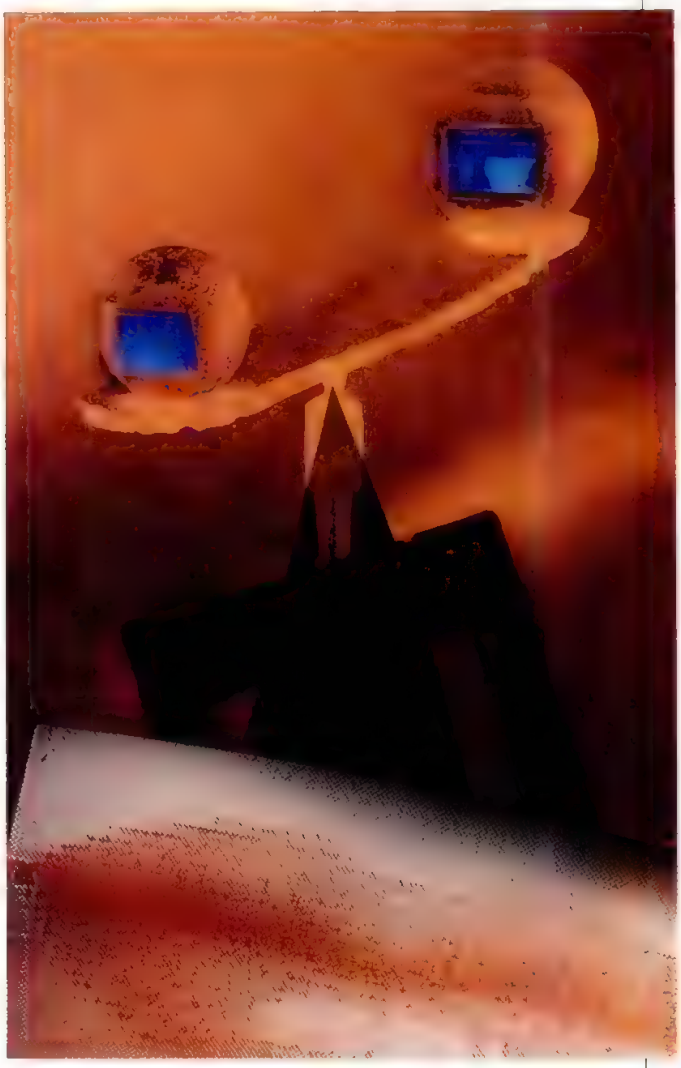
THIS MONITOR HAS A LOT LESS. (27 SQUARE INCHES LESS)

END USER DATABASES

Balance of Power

Has the elusive promise of the end user database finally been fulfilled? Today's best products strike a convincing balance between power and true ease of use.



By Sal Ricciardi

Time was when end user databases were considered to be something of an oxymoron. Anything easy enough for the nonspecialist to use couldn't possibly be for real. Today that common wisdom needs revising. Our look at the current crop of end user databases shows that the line between end user and professional products has all but disappeared. Usability and power are no longer on opposite poles.

End user databases now sport features you'd expect to see in developer-only products, including relational joins between tables, sophisticated query tools, powerful form and report painters, full programmability, and easy connectivity to local and corporate data. These power tools differ from programmers' databases in that they are packaged along with intelligent automated help facilities and some of the most logically designed interfaces

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Photograph by Scott Van Sicklin

we've seen in any software category. If you're willing to master a few basic concepts, these products can deliver professional-quality results.

• Microsoft Access, Version 2.0

End user databases have finally come of age. At their best, these inherently complex products are now as easy to master as any other type of application. The secret lies in the right mix of logical interface design, automated step-by-step help tools, and WYSIWYG screen painters.

Our Editors' Choice award goes to Microsoft Access, Version 2.0, an impressive new release that shows considerable growth from earlier incarnations of the product. Access 2.0's revamped Jet database engine delivered consistently strong performance in our tests, and its Wizards and other well-designed help tools set a new standard for bringing database features within the end user's grasp. The product's intelligently designed interface allows easy management of database structures, and its intuitive visual tools let you work productively with queries, forms, and reports. Access 2.0 offers broad connectivity to standard databases (including SQL) and lets you manipulate data directly in their native table formats. Not all users will

REVIEW CRITERIA

There are literally scores of database products available for the PC. In past years, we applied a filter of flat-file design or nonprogrammability to select end user products for review, but this approach no longer makes sense.

To filter products for this evaluation, we began by identifying databases for MS-DOS and Microsoft Windows that are specifically positioned as end user products by the companies that sell them. We then eliminated any product that hasn't had a significant update since our last review ("Nonprogrammable Databases: Power Without Pain," January 26, 1993). Next, we eliminated those products that did not include a local database engine or whose user interface consisted solely of a language editor. We also ruled out products that use a local SQL database engine. Finally, we screened the remaining selection and eliminated low-end, free-form, or other packages we felt were less interesting to most business end users.

Our final list comprised Alpha Four, Version 3.0, from Alpha Software Corp.; Approach for Windows, Version 2.1, from Lotus Development Corp.; DataEase Express for Windows, Version 1.1, from DataEase International; FileMaker Pro for Windows, Version 2.1, from Claris Corp.; Microsoft Access, Version 2.0; Paradox for Windows, Workgroup Edition, Version 4.5, from Borland International; and Q&A for Windows, Version 4.0, from Symantec Corp. (For a brief look at additional products not covered by full reviews, see "Still Searching?") We also tested a beta version of Approach 3.0 (see "Still to Come: Lotus Approach 3.0") and alpha versions of Paradox 5.0 (see "On the Horizon: Paradox for Windows 5.0") and Appeal 1.0 (see "Appeal: The Future of Databases?"). All these prerelease products are currently slated for distribution this summer.

Improvements like a tabbed-notebook interface can ease your entry into these products.

BOOSTING EASE OF USE

Perhaps the biggest boost to database ease of use comes in the form of automated help features that go by names like Wizards, Assistants, or Experts. Microsoft Access, for example, provides an abundance of Wizards—task-oriented modules that ask you a series of questions and then generate the appropriate object based on your responses. Everything from creating new tables to generating queries can be done by a Wizard.

Q&A for Windows provides DAVE (for Do Anything Very Easily), a help module that leads you through a guided series of menu selections to create queries or perform other tasks. Other vendors have also seen the light and are working to incorporate similar functionality. Lotus Approach 3.0 will include a number of tab-driven Assistants, and Paradox 5.0 will include Borland's Experts.

Visual screen-painting tools are another important aspect of ease of use. These let you create attractive custom form interfaces with GUI features like push buttons or radio buttons without programming. Similarly, laying out a report is usually a matter of dragging and dropping objects and text in a WYSIWYG visual interface. Property managers are often a mouse click away, letting you alter object settings and change appearances quickly and easily. These features are most prevalent in Windows products, but Alpha Four (the one DOS product in the lineup) also offers an easy approach to building simple forms and reports. Finally, basic interface improvements (such as the use of a tabbed-notebook metaphor and visual representations of table relationships) can ease your entry into many of these products.

All of the reviewed databases offer some way to search or query your data without writing code, though they differ in how they implement this function. Four of the databases (Approach, DataEase Express, FileMaker Pro, and Q&A for Windows) support the query-by-form

Our Contributors: SAL RICCIARDI is a contributing editor of *PC Magazine,* and STEPHEN W. PLAIN is a frequent contributor. RICHARD V. DRAGAN is a programmer at *PC Magazine.* JAMIE BSALES is a staff editor and DAN SMITH is a technical analyst at *PC Magazine.* THOMAS MACE was the editor in charge of this story, and JAY MUNRO was the project leader.

need Access 2.0's considerable depth, but for now, this is the product others will be judged by.

An honorable mention goes to Lotus's Approach for Windows, Version 2.1. This product lacks some of the features and polish of Microsoft Access, but it provides a high level of ease of use. Version 3.0, which is expected to ship this summer, shows every promise of being a major challenger and deserves serious consideration.

Borland's Paradox for Windows, Workgroup Edition, Version 4.5, showed strength and depth, although it is not as easy to use as some of its competitors. Version 5.0 will ship this summer with a number of improvements to help harness the product's power.

method. This technique is the most intuitive, letting you query a database by entering values and search conditions into the fields of an existing form. Access and Paradox for Windows supply a dedicated query window where you specify your search criteria by choosing fields and supplying examples. This technique requires more steps but is easily mastered and better suited to complex queries.

ENFORCING INTEGRITY

One high-end feature finding its way into end user products is the ability to enforce data-integrity rules. When you tell your database that the Customer Name field is a required field, you're specifying what's known as a data-integrity rule. Supplying default values, testing that a value is within a certain acceptable range of values, applying formatting characteristics to information such as a phone number, and similar matters involving the accuracy of stored information all relate to the concept of data integrity.

All of the products reviewed here support range testing and default values, and all except Paradox for Windows support auto-incrementing fields. There are differences in how data integrity features are implemented, however. Access unconditionally enforces the rules you specify, whether you're importing data from another source, accessing a database directly, or using Access's programming language, Access Basic. Other products offer less robust methods, enforcing the rules only under certain conditions. Approach, for example, stores integrity rules in View files that are separate from the database file. If you use a different View file or bypass the View file and access a database directly, you'll bypass the rules.

FOREIGN DATA

All of the reviewed products offer some means of importing data in standard formats. But three—Microsoft Access, Approach for Windows, and Paradox for Windows—offer the powerful ability to work directly with a number of different database files in their native formats, without importing. Approach can work directly with data in dBASE III+ and IV, FoxPro, and Paradox tables, as well as with SQL databases from Oracle, Microsoft, and IBM. It also supports SQL access through Microsoft's Open Database Connectivity (ODBC) specification. Access can "attach" to data in dBASE, FoxPro, Paradox, and a variety of SQL databases. Paradox for Windows supports dBASE III+ and IV and several SQL flavors (but not ODBC).

APPLICATION DEVELOPMENT

While Access and Paradox for Windows are the only two products in this evaluation with full-blown programming languages (Access Basic and ObjectPAL, respectively), that doesn't mean the remaining products are incapable of automation. All of the others have either a macro or scripting facility designed to let you string together a series of steps and, for example, attach them to a button.

Two of the packages, FileMaker Pro and Q&A for Windows, retain a simpler flat-file design that limits them to single-table apps like contact lists and mailing labels. A flat-file system can support more advanced applications in theory, but they easily become unwieldy since a flat-file model encourages a high degree of data redundancy. This increases the likelihood of error and makes storage requirements skyrocket. Flat-file databases can be quite

HIGHLIGHTS

End User Databases

HOW EASY can a database be to use while still giving you the power you need? The best of the current crop have the features you need for professional application development yet provide a host of ease-of-use features that deftly guide the novice. Some simple flat-file products can be as easy to use as a spreadsheet.

TALKING SQL to a corporate database server is a trick many end user databases are learning. A product with good query and reporting tools plus ODBC or native driver software to connect to a SQL server can make a strong SQL front end.

WIZARDS, ASSISTANTS, EXPERTS. Whatever they're called, automated help modules that walk you through common tasks can be a powerful helping hand. You'll find them turning up in many (but not all) end user databases. Some even let you work with your own data as you learn. These tools can make easy work of tasks as complex as building a crosstab report.

A RELATIONAL DATA MODEL is now the norm and flat-file databases are fading from the scene. A relational database lets you store data in multiple tables that can be joined for performing complex queries. Flat-file designs limit you to a single table and may force you to enter redundant information.

INTIMATE CONNECTIONS to other products in a company's application suite are another sign of the times. Some end user databases provide intelligent links to spreadsheets, word processors, mail packages, and back-end database servers. Others can even make their database features available in the menus of nondatabase apps.

Suitability to Task: End User Databases

A database can be powerful without being easy to use. But if you can't harness its power, why bother to use it? We rate each database from an end user perspective in four categories of typical database tasks. Power scores are based on each product's raw abilities. Scoring high on ease indicates intuitive menus, toolbars, graphical aids, or interactive help that can assist you in performing any given task.

In the **simple database** task, we look at setting up a flat-file mailing-list database and generating mailing labels. Products earn high scores for a flexible, intuitive approach to field definition and data-entry forms creation. Does the product support a wide range of data types and provide masked fields? Is it able to format standard labels?

With the **forms and reports** task, we consider the product's ability to create visual data-input and data-presentation structures. We look at the quality of screen-painting tools and the range of objects that can be placed on forms. We also test each product's ability to format and generate standard and complex reports. How powerful and intuitive are the report-formatting tools? A WYSIWYG environment improves its product's score.

We next examine **query and analysis** mechanisms, whether query by example or query by form, menu-driven or command-driven. Products not able to execute relational queries are penalized, while extra analysis tools (such as a charting module) earn higher scores. We also look at any available provisions for querying server-based SQL data and the ability to import local data in industry-standard formats for analysis.

Each product's ability to generate standalone applications is measured in our **application development** task. We judge the quality of script languages, macro recorders, or other automation tools. We also consider the presence of full-featured programming languages, debugging facilities, and application distribution tools. How much coding does it take to get an application running?

SUITABILITY TO TASK

Product Name	Power	Ease of Use
Simple database	POOR	EXCELLENT
Forms and reports	FAIR	GOOD
Query and analysis	GOOD	FAIR
Application development	EXCELLENT	POOR

easy to use, however, and their limits may not be important for very simple applications.

The following reviews can help you narrow your choice based on your specific requirements. But whatever product you pick, one thing is clear: This year's crop of end user databases has broken the ease-of-use barrier at last.

Alpha Software Corp.

• Alpha Four

BY STEPHEN W. PLAIN

Not all end user database vendors have been irresistibly drawn to Microsoft Windows. Alpha Four, one of the most time-tested platforms, remains a staunch DOS holdout. The latest release, Version 3.0, offers a highly functional environment for DOS users, especially those whose slower hardware excludes them from Windows offerings. The single-user version of Alpha Four lists for $495 and a three-user network version lists for $595.

EASY BUT RELATIONAL

Alpha Four scales well across a range of tasks. It is easy enough to be your first database program but deep enough to create relational menu-driven applications. Its competitive performance and generally excellent documentation are assets for both types of user. This is strictly a character-based product, however, and Windows habitués may miss their accustomed freedom of font selection and sizing.

Databases in Alpha Four are stored using dBASE-compatible .DBF files and .NDX indexes. You can set the default database format to either dBASE III or dBASE IV, although Alpha Four does not support the .MDX production index introduced with dBASE IV. Fields can be defined as character, numeric, date, logical, or memo values. Although memo fields can be used just like other field types, the actual memo data from a given database is stored in a separate physical file. Each memo entry is limited to 5,000 characters. New tables can be created easily in Alpha Four, and within minutes you can be up and running with your own workable database.

While each table is stored as a separate .DBF file, relational multifile databases can be built using Alpha Four's Set feature. Individual database files can be linked within a Set in one-to-one or one-to-many relationships to form complex relational structures suitable for many business tasks. A Set can also be configured to "cascade" updates and deletions so that when a record in the parent table is updated or deleted, the records in the associated child tables will be updated or deleted accordingly. Conversely, you can define rules that determine how common fields in child tables will automatically be filled in when a parent record is added. By correctly defining these referential integrity rules, you can improve the functionality of your database and help insure the accuracy of the data it contains.

Its DOS face is not as pretty as the others, but Alpha Four is a powerful, time-tested workhorse.

You can manipulate data at will using the View/Enter Records item under the main menu. When you select this option, Alpha Four creates a standard form layout that displays one record per screen. Alternatively, you can switch to a browse mode that displays a scrollable table of the database's records. When viewing

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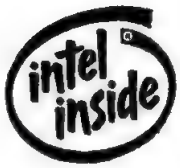

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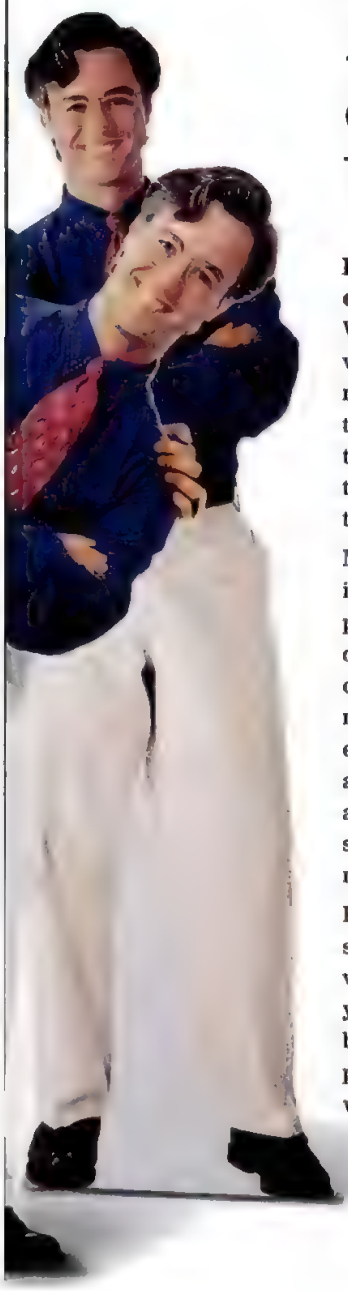

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Benchmark Tests: End User Databases

Our test results underscore just how broad the spectrum of end user databases really is. While some products offer well-oiled, highly tuned performance, others trade speed for simplicity. While there was no obvious front runner across all the tests, Microsoft Access delivered the most consistently strong results.

How We Tested

We tested our end user database lineup using a subset of the AS^{3}AP (ANSI SQL Standard Scalable and Portable) benchmark tests for relational database systems, originally developed at Cornell University by Dina Bitton. Our test database comprised two 10,000-row tables, which were initially generated in unquoted comma-delimited form. Both of these tables have identical schemas. The first is designed to have unique values in every field, while the second is designed to return 10 percent of its records (1,000 rows) in response to all our standard test queries. The raw data for our test database was generated using the AS^{3}APGen program from Dina Bitton and Jeff Millman at DBStar. in San Francisco, California.

We set up and ran all tests at PC Magazine Labs using each product's native interface. Tests were timed with a stopwatch, starting when the button or menu item was selected and ending when the product returned the answer or returned control to the user. In cases where anomalies were suspected, we rebooted the machine and repeated the test.

Our **Load and Index** test measures how quickly the product can import our two 10,000-row comma-delimited files and then index an integer field (the primary index) and a secondary character field for both tables. The numbers shown here are combined times for loading two tables and creating a primary and secondary index on each of the two tables.

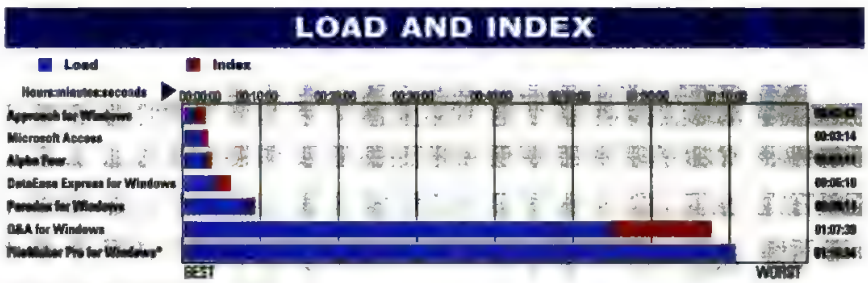
Approach, Version 2.1, came in the fastest on loading, with Microsoft Access, Version 2.0, following close behind. Paradox for Windows 4.5, Alpha Four 3.0, and Access were the speed winners on indexing; Paradox was far and away the fastest when creating secondary indexes. FileMaker Pro for Windows, Version 2.1, was the slowest because it creates indexes on all fields during import. All products except Approach and Filemaker Pro allow you to add or remove indexes after creating and importing data.

The **Full Scan** test measures the time needed to search through 10,000 records on a nonindexed field when nothing is found. The test used a query on an integer field in the unique-value table to search for the value 1, which had purposely been left out. FileMaker Pro was the fastest; because it has previously indexed all fields, it is able to scan an index.

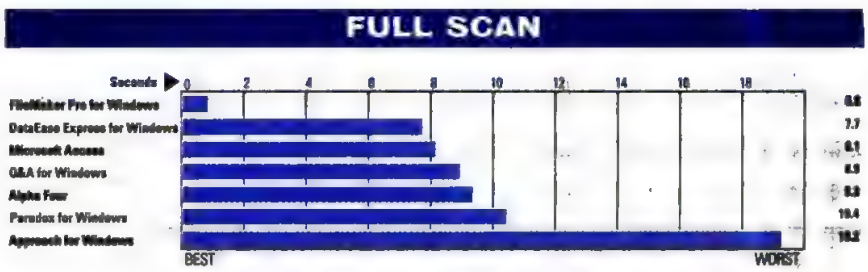
The **Select** test measures the time the product takes to retrieve a group of records from a single table based on specific selection criteria. This test uses two queries based on two data field types: integer and alphanumeric. The integer query is based on the key field of the unique-value table. The alphanumeric query is based on a field in the 10 percent table containing redundant data. In both cases, the query is designed to return 10 percent of total records.

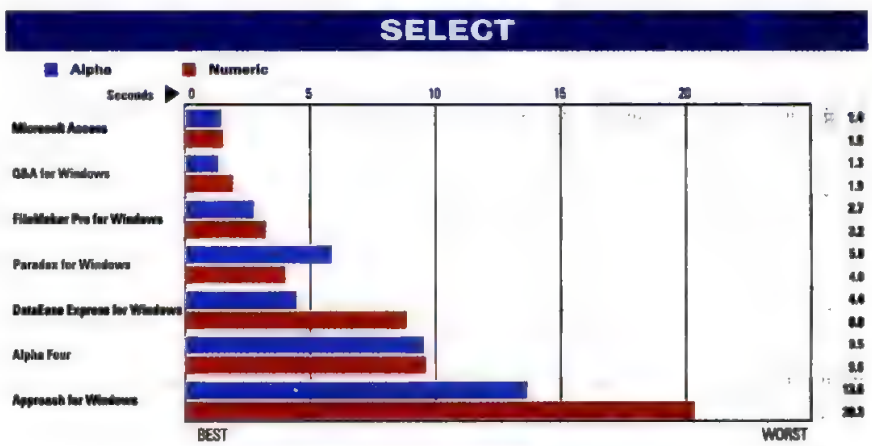
The **Sort** test measures the time needed to sort a table in descending order based on an unindexed numeric field. FileMaker Pro's poor score on this test is again due to its unusual indexing system.

The **Update** test measures the time each tested product needs to select and update 1,000 records in a 10,000-record table. The Modify component of the test queries an indexed integer field for a value of ≤100,000,000 and changes the value to



* FileMaker Pro loads and indexes in a single operation.





~100,000,000. The Delete component measures the time needed to search for the 1,000 changed records and delete them. DataEase Express for Windows was not able to perform this test because it does not perform bulk updates or deletes.

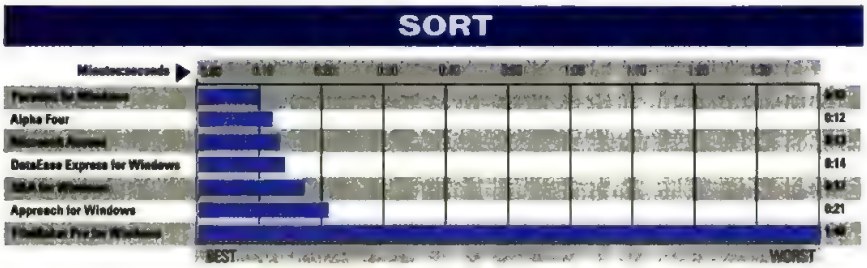
The **Report** test measures how long each product takes to create a standard columnar report based on fields selected from two joined tables. The report accomplishes several tasks: joining two tables based on a key value, sorting by one field in ascending order, calculating subtotals and totals for two other fields, and displaying results.

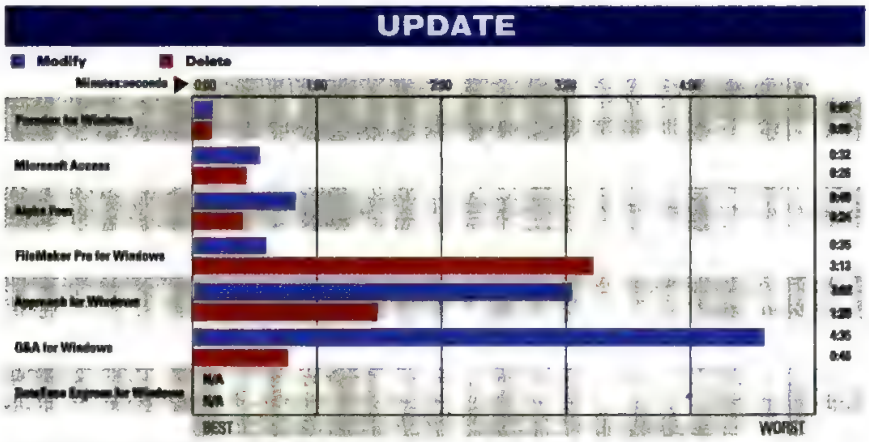
In some cases, we had to measure the time required in two stages, since some of the products (such as Access and DataEase Express) would display only the number of rows required to fill the screen. The second timing measured the length of time it took to get to the last record.

We tested each database on a Compaq Deskpro 486/33M equipped with 8MB of RAM and 340MB of hard disk space. We used MS-DOS 6.2 with SmartDrive write-behind caching disabled. Windows products were tested using Microsoft Windows 3.1 with 32-bit disk access enabled and a permanent swap file. All tested packages were installed using their default installations. Packages with multiple installation options were installed using the Full option or the equivalent.

In previous years, *PC Magazine* has tested end user databases using a smaller, 1,000-row database in addition to the 10,000-row database used in this year's tests. Both databases used an identical two-table schema and were generated using the same algorithm. We dropped the smaller database from this year's tests because we feel that it is no longer representative of the database sizes generated by the reviewed products.

—Analysis written by Jay Munro





N/A—Not applicable: The product does not support bulk updates.

data in a defined set, you can also zoom in on data in a child table that is linked to the currently selected record in the browse table.

FIND MY DATA

A central part of Alpha Four's architecture is the Search/Sort list, a mechanism that lets you filter data to match your search criteria. Search/Sorts can be run once as an ad hoc operation or saved for future use. When the Search/Sort is executed, the data from the currently selected database or set is filtered according to the expressions provided and, optionally, sorted in up to five levels.

SUITABILITY TO TASK

Alpha Four

	Power	Ease of Use
Simple database	GOOD	EXCELLENT
Forms and reports	FAIR	GOOD
Query and analysis	FAIR	GOOD
Application development	FAIR	GOOD

The criteria for a Search/Sort operation can be defined in two different ways: through an easy-to-use Table Mode that prompts you with lists of available fields and operators, or by using Expression Mode, essentially a command prompt that will accept complex expressions including field-value comparisons. Search/Sorts can be executed sequentially, with the results of one search used as the basis for a second. This makes them essential in selecting desired information for reports.

VISUAL PRESENTATION

Alpha Four uses visual paradigms called Layouts for managing data input and presenting output. Layouts can be created for forms, reports, browse tables, mailing labels, and form letters. Up to 26 layouts of any type can be defined for each database.

Browse-table Layouts are customized implementations of Alpha Four's browse mode that let you define the fields to be displayed and the browse operations that can be performed.

The character-based form designer gives you enough power to create simple and multitable forms with ease, but it lacks the sophisticated graphics and visu-

FACT FILE

Alpha Four, Version 3.0

List price: $495. **Requires:** 286-based PC or better, 640K RAM, DOS 3.1 or later. **In short:** DOS users, look no further. This time-tested package lets you build robust database applications and simple turnkey apps that can run on less powerful hardware than today's Windows products. Alpha Four's straightforward menu system and scalable approach make it easy to get started, and you'll find all the functionality you're likely to need in an end user product. The excellent documentation is an additional bonus.

Alpha Software Corp., 168 Middlesex Tpk., Burlington, MA 01803; 800-451-1018, 617-272-3680; fax, 617-273-1507.

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al control of many Windows database systems. In addition to placing regular database fields on a form, you can define regions on the form that display scrollable multiple-record views of child tables within a set. The product's limited font control means a maximum viewable form width of only 80 characters.

Alpha Four's report writer is fundamentally band-oriented, although form-based reports can be approximated using the Custom Report format. Once again, the lack of font control limits the amount of information you can fit on each report page.

Otherwise, the list of reporting features is quite respectable. Groups, breaks, and summary expressions can all be defined. You can also define crosstab reports that create a summary of data from one field based on values from two other fields; unfortunately, this powerful feature is underdocumented.

Mailing labels and form letters are easily created using custom dialogs available under the Layout menu. You will, however, be limited to plain vanilla output due to the program's lack of formatting options. A simple word processor is provided for creating form letters, and you can define conditional paragraphs of text to print according to the values of various database fields.

SIMPLE APPLICATIONS

Alpha Four lets you create simple applications by defining a series of user menus and attaching macros to them. The Application Editor walks you through the process, which is centered around an outline view of the menus you have already defined. Any menu item can have an attached macro, which you can record on the fly by pressing F3 in the Application Editor.

These macros are most often used to present previously defined forms, browse tables, and report layouts. Alpha Four also includes a scripting language that can be used to emulate keystrokes, obtain user input through dialog boxes, and modify the program's standard menu bar items.

The multiuser version of Alpha Four provides record- and file-level locking and automatic screen updates when information is updated by other network users. Passwords can be assigned to menu items in your application to restrict unauthorized access to database elements.

Alpha Four works well for users of all levels of computer expertise and handles the basics of database work naturally. Because of its DOS-based interface and its lack of graphical formatting and charting functionality, Alpha Four is suitable only for the more traditional data management tasks—but it does those very well.

Lotus Development Corp.

• Approach for Windows

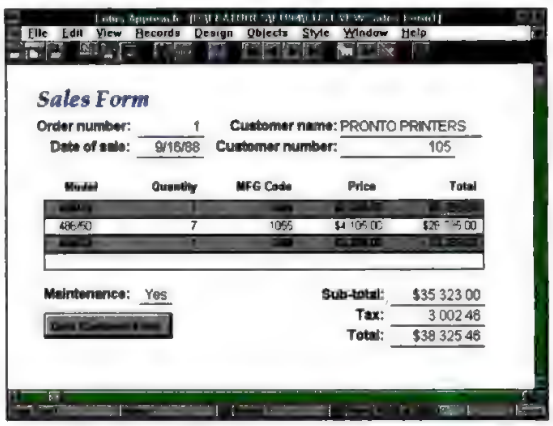
BY SAL RICCIARDI

Lotus's Approach for Windows, Version 2.1, has garnered a well-deserved reputation for simplicity and ease of use. The $395 package excels at helping you quickly perform the most common database tasks, such as creating data entry forms, reports, labels, and form letters. And since the product can work with a number of different database file formats, it also provides quick access to your existing information—including SQL data.

Some users, however, may find this version's lack of fully up-to-date tools and a more powerful application development facility somewhat limiting. A new release, expected by the time this article appears, promises to bring Approach to the forefront of end user databases (see the sidebar "Still to Come: Lotus Approach 3.0").

MODUS OPERANDI

An Approach database is made up of two types of files: database files and view files.



Approach 2.1's interface is usable, if not stellar. See this same form in 3.0's notebook interface on the following page.

A database file stores the basic table structure and your actual data. View files let you store and manage the designs for your forms, reports, letters, and labels. They also contain important information about the database—specifically, the database's validation rules.

You can create and save many view files, and each file can reference many databases. This unusual system was developed because Approach does not have a native database format; instead, it offers you a choice of several industry standard formats. Your access to data is very flexible, but validation rules are not part of the database.

When you want to get at your data, Approach's handy dynamic status bar lets you easily toggle among the program's browse, design, find, and preview modes. The product is especially strong at giving

SUITABILITY TO TASK

Approach for Windows

	Power	Ease of Use
Simple database	GOOD	GOOD
Forms and reports	GOOD	GOOD
Query and analysis	EXCELLENT	EXCELLENT
Application development	FAIR	FAIR

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Still to Come: *Lotus Approach 3.0*

By Sal Ricciardi

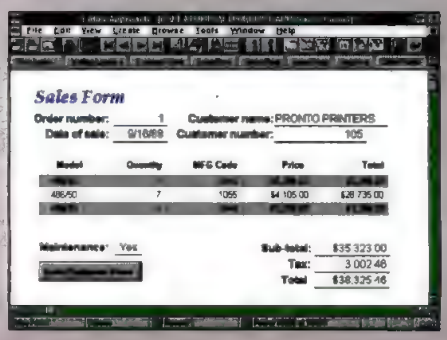
For Approach users, the big moment will come this summer with the release of Lotus Approach for Windows, Version 3.0 (as we go to press, Approach 3.0 is scheduled to ship in mid-June). While it's too early to draw final conclusions, our look at an early beta version of Approach 3.0 convinced us that this release brings a significant new presence to the end user database arena. Features already implemented or slated for the final version include an intuitive new tab-based interface, Wizard-style help, full OLE 2.0 support, and tighter integration with other Lotus applications.

FIRST IMPRESSIONS

The first thing you'll notice is Approach 3.0's new support for database templates, since the opening dialog gives you the option of creating a new database based on one of the 20 supplied templates. Each template is a predefined table structure that gives you a head start on building standard databases such as customers, orders, and employees.

Probably the most obvious visual enhancement is Approach 3.0's new tabbed-notebook interface. Instead of using a menu system to switch between various form, report, and label designs, you click on the appropriate tab to bring that view forward.

This metaphor is extended throughout the new release. For example, a new InfoBox window (accessed from the toolbar) lets you specify properties, styles, and other settings from within a tab-driven dialog. Just click on the toolbar and the InfoBox appears with context-sensitive information based on the currently selected object. You can make changes to properties and settings and see their effect immediately, without leaving the dialog.



The new interface of Approach 3.0. What a difference the tabs make.

The tab metaphor also makes an appearance in Approach 3.0's new online Assistants. Similar to Microsoft's Wizards, the Assistants walk you through tasks such as creating a new form or report. Each tab represents one step, but you are free to select only those steps that interest you while accepting the defaults for others. The Assistants make use of SmartMasters, preprogrammed professionally-designed layouts that you can modify to fit your needs.

Release 3.0 will add named styles to Approach's repertoire. A named style is a group of attribute settings for things like lines, color, and text that you name and save. You can then apply consistent formatting to a number of objects by applying the named style. Named styles also provide a convenient way to change a number of objects at once, since changes to the style effect every object based on that style.

An additional time-saver is the new Fast Format feature. Like the SmartMasters found in Lotus's Freelance Graphics, Fast Format lets you quickly copy an object's attributes and apply those settings to other objects. You merely select a source object, click the Fast Format icon, and click on one or more target objects to apply the attributes from the source.

The new release will add a Worksheet View where you can browse and update information in a tabular, spreadsheet-like format. You will have

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you easy access to your existing information. Simply choose File | Open and select one of your existing database files, and Approach automatically creates a view file, opens up a default data-entry form for your data, and places you in browse mode. You can immediately edit the information in the selected record or use Approach's VCR-style buttons to navigate through the database.

Approach offers great connectivity, letting you view and import data stored in dBASE III+, dBASE IV, FoxPro, Paradox, Oracle, SQL Server, and DB2 databases. You can also import data from delimited ASCII files and Lotus 1-2-3 and Microsoft Excel spreadsheets. Approach supports Microsoft's ODBC specification for generalized SQL access.

To create a new database table, you use the Field Definition dialog box to choose the data type and length of each field. Approach's Data Entry Options dialog lets you set a variety of validation rules for a field. You can indicate that a value must always be supplied, for example, or specify a default value or a permissible range for a value.

Approach also supports a serial number option where you choose a starting value and increment amount, and the product automatically supplies new serial numbers. This could be useful for automatically generating primary keys, though Approach does not support a primary key type per se. To enforce primary key integrity, you must select Unique and Filled In in the Data Entry Options dialog. Because validation rules are stored in view files, different view files can have different validation rules. If you access a database outside of the view file, the integrity rules in the view file are bypassed.

View files are also employed when you join multiple tables together within a database. To join tables, you first place them in the Join window, then click on a common column in each table, and finally

a variety of options for altering the worksheet's appearance. You can easily resize columns and rows and divide the worksheet into independent panes. You can also apply formula calculations to data as you would in a spreadsheet.

A new Crosstab View will let you take a worksheet and summarize data over two or more categories and group information based on the values in a field. For example, you can summarize monthly sales by region or product. You can drag and drop fields to create a crosstab or use Approach 3.0's Crosstab Assistant to lead you through the process. A variety of aggregate calculations are available.

Approach 3.0's new charting support adds easy-to-use graphics analysis to the package. You can choose from approximately twenty different chart types, including pie, bar, line, and area, and from a variety of different layout options and styles.

If you've ever wanted to see real data while designing forms or reports, you're in luck. Approach 3.0 can display sample data while you work in Design mode, giving you better visual control and making it easier to accurately size and position fields.

The improved report writer includes this WYSIWYG design mode in addition to a banded-style work area. Other report-generation improvements include single-click tools that can instantly sort and group data and generate totals, averages, and counts. For example, there's a Sort with Trailing Summary icon that automatically sorts a report on a particular field and inserts a summary panel after each group (to sort and summarize sales by date, for example).

Approach's macro facility is also being enhanced with some 40 new commands. A macro dialog offers a pull-down list of available commands, and you'll be able to create macros that trigger on entry, update, or exit of a field or view and that support conditional branching.

INTEGRATION WITH LOTUS APPS

Approach 3.0 will also include a high degree of integration with Lotus 1-2-3 and Lotus Notes. When you install Approach 3.0 on the same system with Lotus 1-2-3, Version 4.01 or higher, you will automatically be able to access Approach browsing and reporting features from Lotus 1-2-3 menus.

Integration with Lotus Notes will be particularly strong. Approach 3.0 will be able to act as a front end for querying, updating, and reporting Notes data, and it will also support Notes F/X (Field Exchange) for automating information flow in Notes-based workgroups. Approach 3.0 is also mail-enabled for Notes Mail or any VIM- or MAPI-based system. All in all, there's lots to look forward to in this coming release. □

choose the Join button. Approach draws a line linking the columns in the tables to indicate that they are joined. Choosing the Options button in the Join window lets you set up referential integrity rules.

BUILDING OPTIONS

Creating custom form designs is easy. Choose a starter set of fields, and Approach generates a default form design. Enter Approach's design mode to move and manipulate the objects and to place new objects on the form, such as text, fields, push buttons, and check boxes. Click on any object with the right mouse button and you'll get an object-specific options menu. When working with fields, this menu leads you to the Field Format dialog, where you can apply a date, time, numeric, or text format to the column.

Forms can have repeating panels, a feature which lets you easily create one-to-many forms. Placing a button on each line in a repeating panel is not a tedious chore, since anything on the first line repeats. You can then have that button execute a macro to call up details on a line item, for example.

Approach's query-by-form capabilities let you use these same custom-designed forms to specify queries. To specify search criteria, you simply type values and expressions into the appropriate fields on the form and click on the Find icon. Approach then restricts your view to the matching records contained in the results set. (To switch back to all records, just click on the Show All icon on the Toolbar.) Approach's query-by-form technique is natural and easily mastered and capable for most simple queries.

Creating form letters is also a snap, as is setting up mailing labels. Just place columns and text together on a page in form-letter design mode. You can choose from a variety of predefined Avery label types or define your own label. Approach automatically closes up blank lines and spaces on the printed label, provided you don't overlap elements in design mode. Preview mode lets you see what your form, report, label, or letter will look like when printed.

Reports are designed much like forms, letters, and labels. You use design mode and Approach's toolbar icons and dynamic status bar to help lay out the report elements. You can create standard, columnar, and banded reports. A number of grouping and summary options are also available.

APPROACHING AN UPGRADE

Version 2.1 of Approach is not without shortcomings. This iteration, for example, lacks context-sensitive help and charting capabilities. That's all going to change

▶ FACT FILE

Approach for Windows, Version 2.1

List price: $395 **Requires:** 286-based PC or better, 2MB RAM, 12MB hard disk space, DOS 3.x, Microsoft Windows 3.x, 386-based PC or better, 4MB RAM, and Windows 3.1 or later recommended **In short:** Approach 2.1 is an easy-to-use database whose strong points include access to a range of data types and an intuitive query-by-form capability. It excels at quickly performing basic database access, editing, and reporting tasks. Version 3.0 will dramatically enhance Approach's usability and add SQL connectivity.

Lotus Development Corp., 311 Penobscot Dr., Redwood City, CA 94063, 800-343-5414, 415-306-7890, fax, 415-368-5182

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with Version 3.0, which we looked at in beta. The new version is replete with excellent help, including on-line assistants to walk you through tasks. The new built-in charting engine produces a variety of 3-D graphs. And while 2.1 lacks some of the user interface pizzazz of more recent products, 3.0 introduces an elegant and intuitive tabbed-notebook UI design.

All in all, Approach 2.1's preprogrammed support for database basics like access, edit, and reporting tasks makes it ideal for novice users who need more power than a flat-file database can deliver. It also offers excellent connectivity to other data sources. While no longer quite the cutting edge, Approach 2.1 remains a most impressive tool.

DataEase International Inc.

• DataEase Express for Windows

BY STEPHEN W. PLAIN

DataEase Express for Windows, Version 1.1, is the latest release of one of the pioneer end user databases for Microsoft Windows. This relational product sports respectable performance and some very powerful features but is inhibited by a confusing user interface and haphazardly organized documentation. Getting beyond the basics also means grappling with the product's query language. If you've developed applications in DataEase 4.5 for DOS, you may be interested in DataEase Express, since it represents an interim step to the company's as yet unreleased DataEase for Windows. DataEase Express for Windows lists for $395.

SUITABILITY TO TASK

DataEase Express for Windows

	Power	Ease of Use
Simple database	GOOD	FAIR
Forms and reports	FAIR	FAIR
Query and analysis	FAIR	POOR
Application development	GOOD	POOR

CONFUSING WELCOME

Building a database in DataEase Express means creating what the product calls an "application." This somewhat misleading term refers to a loose collection of such objects as tables, forms, menus, and reports that are represented by the Catalog—a container window roughly comparable to Microsoft Access's Database window.

While this visual organization of key objects in your design is useful, users unfamiliar with DataEase may make a basic error the first time they attempt to create a table. You'll look in vain for a New Table command in the File menu. Instead, you begin by selecting File | New Form and specifying that the form create a new table automatically. This creates a table object with the same name as the form. The table object can be used to access data; but since the form defines the table, the form must also be used to make any structural changes to the table. If all this seems unnecessarily confusing, welcome to DataEase Express.

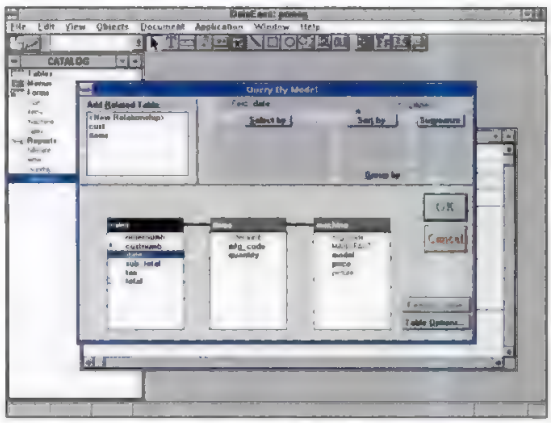
KEY BUILDING BLOCKS

Documents (which can be forms, reports, or menus) are the key building blocks of DataEase Express applications. One nice feature of the product is its ability to switch between a User View to run a document and a Designer View to modify it. You can do this at will from just about anywhere in the product via toolbar buttons. DataEase Express supports style sheets, a saved set of visual styles that can be applied to a particular document or used as the default for new document objects you create. This useful feature lets you design a document with a standard set of colors and line styles and easily apply the same settings to your other documents. The product comes with several prebuilt style sheets.

While these features simplify your work visually, things are not so straightforward at the file level. DataEase Express uses an arguably bizarre file-naming convention designed to make it consistent with earlier DOS versions of the product. Each database table is defined by many separate physical files that hold the table's field definitions, data, document layout, style sheet characteristics, and indexes. This system lets you assign logical table names that are longer than eight characters, but the resulting partially coded filenames can be confusing. DataEase Express normally tracks these files transparently, but if you ever move a database you'll find yourself puzzling over them because you'll have to do it manually.

LAYING THINGS OUT

Form design is one of DataEase Express's strongest elements. A Designer View toolbar provides a number of visual tools for creating interface objects such as text, data fields, buttons, subforms, and image boxes. With these, you can quickly paint data entry forms that suit your needs. Defining a new table while laying out new fields on a form is the best approach to getting started on a new application and lets you plan your database in a visual manner. Within a data entry form, command buttons can be assigned predefined actions such as Delete Record and Save as New Record that automate common operations without coding.



DataEase Express's Query-by-Model dialog is an advanced point-and-click tool that lets you easily create queries.

A similar interface painter is provided for creating custom menus for your applications. Menus are not of the traditional pull-down variety but of a special type of form that typically contains command buttons to take you to other forms in your application.

As you place each new field on the form, you are brought into the Field Definition dialog, a multifunction interface that lets you define a surprising amount of your application's behavior. By selecting the appropriate option buttons, you can move among dialogs that define a field's type and security characteristics, its derivation formula for default and calculated values, its validation for-

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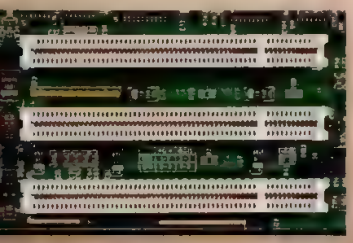

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CIRCLE 126 ON READER SERVICE CARD

FACT FILE

DataEase Express for Windows, Version 1.1

List price: $399. **Requires:** 386-based PC or better, 4MB RAM, 12.5MB hard disk space, DOS 5.0 or later, Windows 3.1 or later. **In short:** A frustrating paradox of strengths and weaknesses, DataEase Express for Windows is tough to recommend at this juncture. It offers a strong feature set and a good forms designer—even a powerful embedded query language borrowed from its programmable sibling, DataEase 4.5. But you will have to live with poor documentation and an awkwardly conceived user interface

DataEase International Inc., 7 Cambridge Dr., Trumbull, CT 06611; 800-243-5123, 203-374-8000; fax, 203-365-2317.

479 on reader service card

mula, and even the help text to be displayed for the field. The derivation and validation sections offer a point-and-click formula builder that lets you paste field names, operators, and functions together. A flaw of this otherwise powerful tool is the absence of adequate on-line help.

DataEase Express provides a "virtual" field type and a highly useful feature called projective expressions. Virtual fields are fields that are defined for a table and derived from a formula but are not physically stored on disk—for instance, an invoice total. Each time a record is edited through a form, the value of the virtual field is recalculated and displayed. Projective expressions are similar but are associated with a specific form or view rather than with the table itself.

QUERIES AND REPORTS

There are three ways of querying data in a DataEase Express table: by model, by form, and by statements built using the product's DataEase Query Language. The Query-by-Model dialog is an advanced point-and-click tool that lets you create relational queries (complete with sort orders and summary specifications) for a query or a new report. A query by form is initiated through the Select Records command. You can enter either literal values or expressions into the fields of a form, which makes queries on multiple fields a snap.

Reporting in DataEase Express has its strengths and weaknesses. Using the Query-by-Model dialog, you can create a report layout involving multiple tables rather easily. But visually adjusting the layout to fit your needs is difficult and becomes nearly unmanageable when more than two tables are involved.

A customizable mailing-label layout is available, but standard Avery formats are not directly supported. The product also lacks crosstab support and built-in charting functionality.

During testing we experienced many situations where it was unclear how an operation should be performed—or whether it could be performed at all. The answer often turned out to be a "trick" which the company had to explain to us.

On the whole, DataEase Express falls short of the current state of the art in end user databases. It delivers competitive performance, some powerful relational capabilities, and programmable flexibility. But not nearly enough effort has gone into user-friendliness, on-line help, or documentation, which is a pity given this product's other strengths.

Claris Corp.

• FileMaker Pro for Windows

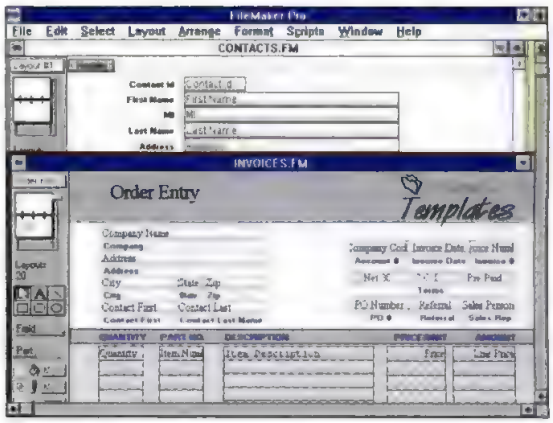
BY RICHARD V. DRAGAN

With FileMaker Pro for Windows, Version 2.1, Claris Corp. presents an intuitive flat-file database for individuals and workgroups. The $399 package delivers fast query performance, an easy-to-use forms and reports designer, and compatibility with databases built using the Mac version of the product.

Before you commit, though, you need to consider some big limitations. FileMaker's nonrelational design, 32MB maximum database size, and lack of connectivity to server-based SQL data may prove too constraining for your needs.

THANKS, MAC

True to its Macintosh roots, FileMaker offers a simple and logical interface that successfully takes away the complexity of designing a database. Simply click on layout mode and start constructing your input forms. As you place each field, FileMaker prompts you for the field's data type. The program supports a number of field types including variable-length text, numbers, date and time values, pictures (including QuickTime for Windows movie clips), sounds, calculated



FileMaker's graphical layout mode and handy templates let you construct handsome forms for your database.

fields, and summary fields. For each field type, you can set a variety of attributes including data validation, masking, value sets, and lookups in other tables. For calculated fields, you can choose from an impressive collection of over 60 macro-like functions, which are all available instantly with a click in a list box.

A database can have several different layouts, offering different views of the same data. One screen you design might be better for data entry, for example, while another might be preferable for a report. FileMaker ships with sample groups of layout templates, which you can adapt to meet the most common database tasks (such as inventory, order entry, contact management, and expense reports). You can combine text and graphics with database fields to create custom forms with a polished, professional look. The layout design tools let you select layout objects by type (all database fields or all rectangles, for example) and globally modify their attributes, which saves time and helps ensure a consistent look for form elements.

WORKING WITH DATA

Once you've designed your forms, simply click into browse mode to add or delete

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CIRCLE 359 ON READER SERVICE CARD

Appeal: *The Future of Databases?*

By Stephen W. Plain

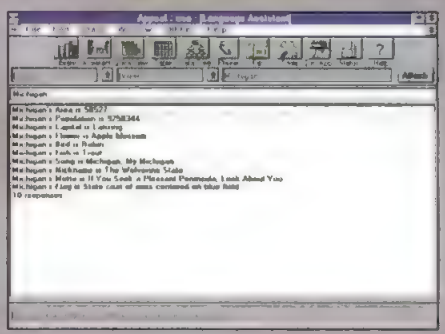
As long as there have been databases, there have been those who strive to make them easier to use. A common approach has been the use of natural-language interfaces (Symantec's Q&A for Windows is an example) that let you retrieve data with plain-English statements like "show me all customers in New York."

Winformation Software believes that it has a better twist on the idea. The company claims that its upcoming product—Appeal, Version 1.0—will provide the ease of natural-language queries, the simplicity of a low-end flat-file database, and the data management power of full-fledged relational products. We looked at an early beta of Appeal, which is slated to ship sometime this summer. It's far too early to tell whether it will deliver on its promises, but we found its fresh approach intriguing.

AUTO-RELATIONAL EASE

At the heart of Appeal is the company's homegrown auto-relational database model. Auto-relationality allows each piece of data to be related automatically to every other piece in the database as it is entered, eliminating the need to create the structure beforehand. This lets you skip a potentially challenging design hurdle and jump right in with entering data. Auto-relationality also minimizes storage requirements, since it stores each distinct value only once within the database. It is unclear how this arrangement will effect performance, although the company claims excellent speed, even with large data sets.

Each chunk of data is stored in Appeal in three parts, forming a construct that the company refers to as a relation. These parts are the subject, attribute and value, where <Subject>'s <Attribute> is <Value>. For example, a relation can express the statement: "California's capital is Sacramento." This easy-to-understand syntax also lends itself to a natural-language interface, and Appeal includes a Language Assistant window that lets you enter data or query it using the above method. Through the Language Assistant you could also type the word "California" and immediately get all of the information related to California.



Appeal's Language Assistant window offers a natural-language interface for queries.

Chances are, you will want to work with your data in a more structured way most of the time. Appeal uses its concepts of Sets and Views to provide this control. Unlike a traditional relational view, a View in Appeal is merely a filter through which to *look at* data; it is not the data itself. Views can be saved and provided to users as a way of limiting the data they can access. Sets in Appeal let you define subsets of the whole database, such as "suppliers" or "company phone list." When you make a set active, subsequent operations on the database occur just on that set.

In addition to its innovative data engine, Appeal is planning an ambitious feature set for the first release. It will include visual form and report painters, OLE 2.0 support, and a charting engine with several two- and three-dimensional chart types. More ambitious still are its planned multidatabase and distributed database connectivity elements. But even if Appeal delivers only half of its slated functionality and performance, it will be a true innovation. □

▶ **Appeal, Version 1.0.** List price: *$299.95.* Requires: *386-based PC or better, 4MB RAM, 4MB hard disk space, Windows 3.x.* Winformation Software Inc., *24982 Buckskin Drive, Laguna Hills, CA 92653; 714-362-0772.*

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records. You can populate the database directly or import existing data from .DBF, .WKS, and text files—a less comprehensive list than some of the other products we cover. If you plan on repeatedly importing chunks of data, however, be warned: In our performance tests, FileMaker was particularly sluggish when importing data because the program builds indexes on every field.

In traditional relational database design, programmers predict the ways users are likely to search for data. But by indexing all fields—and every individual word within text fields—FileMaker Pro is always ready to search for anything the user might want to find, and individual values can be found more quickly.

Browse mode is also used for searching, sorting, and editing database records. You can update or delete a retrieved group of records in bulk. Be aware that when you delete a record in FileMaker, it's gone forever. FileMaker's handy Save a Copy feature gives you a convenient way to back up a database before performing heavy-duty maintenance.

FileMaker offers flexible reporting capabilities for displaying and printing your data. The program offers good support for summary fields (both leading and trailing summaries) by groups of records, while its repeating fields let you place embedded detail records within reports (as with an inventory product database with multiple part items).

Again, you can design your own reports from scratch or use the handy templates. Templates for the most common business uses are provided, including a columnar report (which gives a spreadsheet look to your data) and a single-page form style (which allows for summaries of groups of records). Default reports for creating mailing labels and envelopes are also available, and you can specify text and graphics as "sliding object" to eliminate unnecessary white space between fields automatically. For mail-merge work, a spell-checker is included in the package. You won't be able to graph data in reports, however, as FileMaker lacks a charting module.

SUITABILITY TO TASK

FileMaker Pro for Windows

	Power	Ease of Use
Simple database	EXCELLENT	EXCELLENT
Forms and reports	FAIR	EXCELLENT
Query and analysis	FAIR	EXCELLENT
Application development	POOR	GOOD

POWER USERS AND MULTIUSERS

FileMaker includes scripting support with a tool called ScriptMaker. This tool records a series of operations, such as opening a database file, sorting it, and printing a report, and lets you edit the commands manually. There are over 60 script commands that let you automate virtually any procedure. With ScriptMaker, you can attach scripts to buttons or fields placed on your layout forms, letting you move between multiple layouts or even different databases with a click of the mouse.

FileMaker lets you design database layouts that run unchanged in both Mac and IBM-compatible environments, a boon for organizations with both types of machines on shared networks. Users can even share the same database files. FileMaker also provides solid database-administration tools for managing a workgroup of FileMaker users. You can create and manage groups of users and assign passwords for access rights to certain layouts and activities. With a little planning, FileMaker can be used to manage a small department of up to 25 PC and Mac users. To enhance these workgroup capabilities, Claris has announced a Macintosh server version of FileMaker for use on the Power Mac and higher-end Mac systems. A NetWare Loadable Module (NLM) for PC users will follow. A runtime version of the product, to facilitate the development of FileMaker solutions, is also in development.

HITTING THE HURDLE

Potential users must bear in mind, however, that for all its ease and power, FileMaker is still a flat-file database. That means severe limitations. You must put all data in one table, of course, rather than having related information in separate tables associated by joins. Larger, more complex databases—say, where you store customer information in one table and their order histories in another—are not possible.

One innovation that tries to make up for flat-file limitations is FileMaker's concept of repeating fields, which let you store up to 1,000 detail fields as part of a single record. This makes it significantly easier to represent one-to-many data relationships, since you would otherwise have to enter large amounts of redundant data manually. Additional constraints are that your access to dBASE data is limited to importing tables and you have no ability to access SQL databases.

The manuals in FileMaker Pro are clearly written and the on-line tutorials provide a solid guide to mastering the ins and outs of the environment. FileMaker's limitations will force many to look elsewhere, but for small databases or small departments with a mix of PCs and Macs this convenient and skillfully designed package might fill the bill.

▶ FACT FILE

FileMaker Pro for Windows, Version 2.1

List price: $399 **Requires:** 286-based PC or better (386-based PC or better recommended), 3MB RAM, 4MB hard disk space, Windows 3.0 or later **In short:** If a flat-file database fits your needs, FileMaker is worth a look. It is easy to use and offers workgroup capabilities. Databases you create can be shared with the Macintosh version of the product, which makes the product ideal for mixed PC/Mac sites. FileMaker indexes every field in your database, so search performance is fast; but you're limited to a maximum database size of 32MB

Claris Corp., 5201 Patrick Henry Dr., Santa Clara, CA 95052, 800-544-8554, 408-987-7000, fax, 408-987-7460

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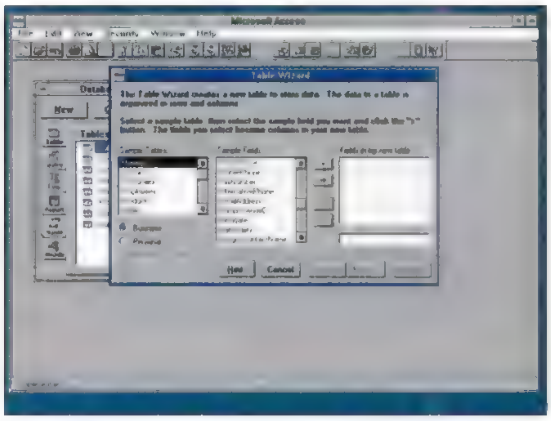
Microsoft Corp.

EDITORS' CHOICE

Microsoft Access

BY STEPHEN W. PLAIN

Microsoft Access, Version 2.0, is the second major revision of Microsoft's end user database and has arguably become the most scalable product in its class. An impressive array of new features and usability improvements—including a host of new Wizards—makes this powerful $495 tool appropriate for database novices and corporate developers alike.



Wizards for creating tables and queries make using Microsoft Access an almost documentation-free experience.

STRONGER FOUNDATION

Improvements to Access 2.0 begin with its underlying Jet database engine that now incorporates portions of Microsoft's Rushmore technology, originally developed in FoxPro prior to Microsoft's purchase of that product. Rushmore optimizes queries by leveraging existing index data to reduce the need to access table data. In our speed tests, Access 2.0 delivered the best query (Select) performance of the lineup and was consistently among the highest scorers across the board.

Other low-level enhancements include

the ability to enforce data-integrity rules at the database level via cascading updates and deletes. This feature lets you establish rules for determining how records in child tables are affected when a parent record is modified, thereby reducing the amount of code required for building full-fledged apps.

WIZARDS COME TO LIFE

When you create a database in Access 2.0, all of its components—tables, queries, forms, reports, macros, and code modules—are stored in a single .MDB file. Your work revolves around the Database window, an easy-to-understand tabbed-notebook list box that displays these component elements by category as you select the corresponding tab. Each object in the database can be executed or opened in a design view from the Database window. Clicking the New button starts the process of creating an object of the selected type, and it is here that the Wizards come to life, making quick work of getting functional designs off the ground.

One of the most powerful assistants is the new Table Wizard that guides you through the process of defining a new table and establishing its relationships, if any, to the other tables in the database. The Table Wizard also provides over 40 model personal and business tables, each with its own set of formatted fields to pick from for use in your own database.

Defining database fields (and many other database objects, for that matter) involves setting properties that define fields' visual characteristics and behavior. In previous versions of Access, relationships between tables were defined in a window one pair at a time. Access 2.0 adds a graphical Relationship window that displays all database tables with interconnecting lines representing active relationships. You simply drag from a field in one table to one in another to define a relationship and then customize the link.

Access 2.0 can use data from a variety of sources, including dBASE III+ and IV, FoxPro 2.0 and 2.5, Paradox 3.*x* and 4.*x*, as well as Microsoft, Oracle, Sybase, and ODBC-compliant SQL databases. You can choose to import this data, but Access 2.0 also offers the powerful option of "attaching" to external tables and working with their data in their existing format. Access 2.0 databases cannot be accessed directly from Visual Basic 3.0, however. Microsoft has promised compatibility using the upcoming Access Developers' Toolkit and the company's $49.95 Office Development Kit.

QUERY POWER

The Access Query window shows you a graphical representation of your tables and provides a scrollable grid that lets you define the entire query in remarkably few steps. To add a field to a query, you simply double-click on its representation in the diagram or drag it down to the grid below. The grid lets you specify the sort direction and whether the field's value should be displayed in the query result; it also provides multiple cells in which to place search criteria.

Right-clicking on a Criteria cell and selecting Build from the resulting pop-up menu brings up another new feature of the product: the Expression Builder. This tool lets you simply point-and-click to build complete expressions from pick lists and includes a listing of functions available in the program's macro language, Access Basic. In addition to the standard query design view, Access 2.0 provides a SQL window that displays the equivalent SQL statement for the query and lets you edit the SQL directly. The two views of a query stay in sync very well, providing not just two ways to query data but a mechanism to generate SQL statements.

A Query Wizard is also available to help you create commonly used queries such as crosstabs, duplicate records, and records without related records in a child table. The crosstab is the most impressive, since it uses a simple, step-by-step approach that generally gives you what you want the first time.

Query results are typically returned as dynasets, table-like views of selected live data located in one or more of your actual tables. Updates or deletes made to dynasets are reflected in the underlying tables. This powerful feature is not new to Access 2.0 but is still not matched by most competitors.

EASY FORMS

The form designer in Access 2.0 is superb. New Wizards have been added that let you create not only the type of form layout you want, but the particulars of visual controls placed on the form. Command buttons, list boxes, option groups, and graph objects all have their own Wizards that present you with examples of frequently-used objects. Command button Wizards offer predefined responses to click events that cover everything from record navigation to launching other Microsoft applications.

New Autoform and Autoreport features let you create default reports and forms with just a single click. Combined with Query Wizards, these features let you quickly generate forms and reports that require only minor alterations, if any, to meet your needs.

Reports are designed similarly to forms, with Wizards and visual tools to aid the task. While there is no form letter Wizard per se, a Mail Merge Wizard is provided to work with Microsoft Word 6.0. The product also includes the powerful charting engine used in Microsoft Excel.

SUITABILITY TO TASK

Microsoft Access

	Power	Ease of Use
Simple database	EXCELLENT	EXCELLENT
Forms and reports	EXCELLENT	EXCELLENT
Query and analysis	EXCELLENT	EXCELLENT
Application development	EXCELLENT	EXCELLENT

FACT FILE

Microsoft Access, Version 2.0

List price: $495. **Requires:** 386SX-based PC or better, 6MB RAM, 19MB hard disk space, DOS 3.1 or later, Microsoft Windows 3.1 or later. **In short:** This second generation of Access shines. Microsoft has worked its time-saving Wizards into nearly every cranny, making Access a breeze to use. Its scalable power (including native SQL connectivity and OLE 2.0 support) will suit the needs of both novices and corporate developers, and Microsoft's Rushmore technology boosts database performance.

Microsoft Corp., One Microsoft Way, Redmond, WA 98052; 800-426-9400, 206-882-8080; fax, 206-936-7329.

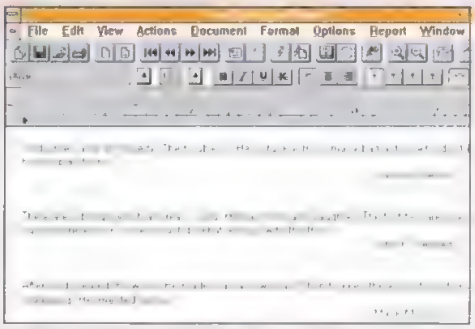
481 on reader service card

Still Searching?

By Jamie Bsales, Jay Munro, and Dan Smith

The spectrum of end user database products is broad, and scores of products are available. Some are brand-new Windows entrants and some are as old as the PC itself. Here we glance at some of the more interesting products that did not receive full review in our main story. You may find one whose specialized capabilities suit your needs.

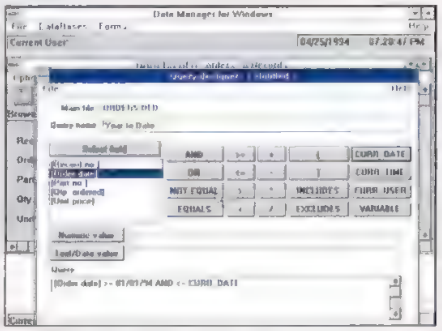
One decidedly different database is **askSam for Windows, Version 1.0** ($395; askSam Systems, 800-800-1997, 904-584-6590), a Windows port of the popular DOS product. AskSam is billed as a "free-form" database ideal for storing and tracking text-intensive documents such as e-mail. Simply import the memos into an askSam file and flag each element—Date, To:, From:, Re:, the body, and so on—as a separate field. You can then set a query and retrieve just the documents you're looking for; all e-mail messages from your boss, for example, or any memo that contained a key word or phrase. Writers and researchers could download papers or articles and have them easily searchable—no more hunting through clippings to find that reference you vaguely remember seeing. Each database record can contain 16,000 lines of text, and askSam can import text-only, rich-text-format, WordPerfect, and dBASE data.



If you need to catalog text-intensive material using a database, askSam is ideal.

To get you started quickly, the package contains a good selection of predesigned templates for use with more traditional database information, though your forms and entry screens won't have as polished a look as some other products. Still, if you primarily need to store, organize, and search text documents as if they were database records, askSam is the answer.

Data Manager for Windows, Version 3.1 ($49.95; Timeworks International Inc., 800-323-7744, 708-559-1300), is a powerful, easy-to-use database with a full GUI screen designer, banded report writer, network capability with multilevel password protection, and a point-and-click query builder. In addition to the standard data types, the package supports image, pop-up, memo, and serializing fields. Timeworks has promised a needed overhaul for the visual screen builder, which will make this full-featured Windows database even more of a bargain.



It doesn't get much easier than Data Manager's point-and-click query builder.

The easy-to-use interface of **File Express, Version 5.1** ($99; Expressware Corp., 800-753-3453, 206-788-0932), makes creating tables, forms, and reports a simple task. The lookup and macro capabilities of this DOS-based package make it ideal for creating forms and reports that manipulate data from multiple tables. A good tutorial and context-sensitive help guide you through every stage of database development.

PC-File, Version 7.0 ($149.95; ButtonWare Inc., 800-528-8866, 206-865-0773), is a DOS database package that nonetheless sports a handsome GUI, complete with mouse support and pull-down menus. The interface walks you through the process of creating a database and defining fields; the easy-to-use package includes good documentation if you get lost. Tops on the long list of features are relational lookup capabilities to access data from different tables, a spell-checker and letter writer for mail-merge work, and a built-in charting engine.

Ultra-Plus Advanced, Version 2.54 ($429; Fairhaven Software, 800-582-4747, 617-341-1990), is a powerful database package for those PC users with not-so-powerful hardware: A 286-based machine and 384K of RAM will do just fine. Ultra-Plus is a relational file manager that lets you perform lookups and calculations across database tables. An excellent on-line "guided tour" will help the most novice users get started, and the clear user manual, with a comprehensive table of contents and index, can take them from there.

The menu-driven interface, now with mouse support, gives quick access to the most often-used database functions. The new version also offers easier-to-use application- and screen-design tools. And for those users who want everything done for them, Fairhaven offers a prebuilt Contact Manager application ($49) plus ready-to-go add-on modules ($99 each) for legal, accounting, property-management, and general contracting databases. □

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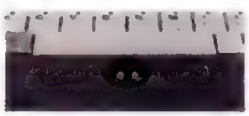

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CIRCLE 012 ON READER SERVICE CARD

Additional integration with other Microsoft Office applications is provided by three new buttons on the toolbar called Mail It, Analyze It, and Publish It that send data from a selected object to Microsoft Mail, Excel, or Word, respectively. Access 2.0 supports OLE 2.0 as a container application, meaning you can embed OLE 2.0 objects within forms and reports.

For a company that didn't have an end user database product just a few years ago, Microsoft deserves kudos for the impressive success of Access. The product's polished technology and user-friendly Wizardry are a major step ahead of currently shipping competitors and put professional-level power into the hands of nonspecialist end users.

Borland International Inc.

• Paradox for Windows, Workgroup Edition

BY STEPHEN W. PLAIN

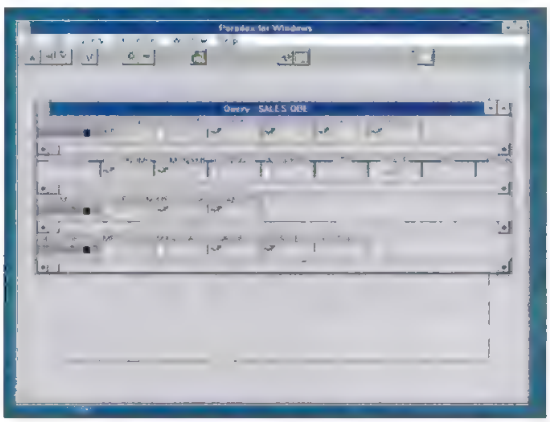
Paradox for Windows, Workgroup Edition, Version 4.5, straddles the gap between end users and programmers with its intuitive working environment and rich development platform. Powerful query-by-example capabilities, the product's most striking feature, let end users intuitively navigate data on multiple tables—even server-based SQL tables.

While Paradox for Windows is not as easy to master as some other end user databases, those willing to scale the learning curve will enjoy the benefits of a powerful relational database. A standard edition of the product ($149.95) does not offer the Workgroup Edition's transparent links to SQL data or Borland's OBEX engine for distributing information to LAN-based and remote users.

POWERFUL QUERIES

Paradox is built around relational access to data; that is, data is organized in multiple related tables that can be compared in order to generate new lists of data matching your search criteria. While the product lets you fully control an end user's view of data by use of custom forms, it is the relational view of the data that provides the powerful ad hoc querying power that made Paradox famous. Paradox's query-by-example (QBE) interface lets you quickly define even the most complex queries and save them for later use. The easy-to-understand QBE Window presents you with a schematic view of the fields in each table included in the query. You define the characteristics of the query by editing these schemas.

The query-building process is made even easier by Paradox's efficient toolbar, called the Speedbar. You can easily create joins between tables by clicking on the Speedbar's Joins icon and then on the common fields of each table to be joined. When you've done this, tokens appear in the fields to show that they are related. You complete the query by checking each field you want to include in your answer set and entering filter criteria for any fields you wish to filter data on. After you execute the query, the resultant data is returned to a new table, which you can manipulate much like a normal table. Of course, this whole process assumes the end user understands the structure of the database, the concept of joins, and the meaning of each field name.



Paradox's QBE window presents you with a schematic view of a database; building even complex queries is a snap.

Each table you create is saved as a separate file. In addition to its native .DB file format, Paradox can be used to create and manipulate dBASE III+ and dBASE IV databases. Unlike many other products that support the dBASE .DBF format only, Paradox can also create and maintain dBASE .MDX production indexes. If you have an existing dBASE application, you should have no problem accessing its data with Paradox.

You can use a broad range of field types including currency, memo, BLOB (binary large objects), picture, and OLE objects. Paradox can import delimited and fixed-length text and a variety of common spreadsheet formats. Unlike most products that append imported data to the currently opened table, Paradox creates a new table for the new information. An Add utility lets you append the newly created table to an existing one.

SUITABILITY TO TASK

Paradox for Windows, Workgroup Edition

	Power	Ease of Use
Simple database	EXCELLENT	GOOD
Forms and reports	GOOD	GOOD
Query and analysis	EXCELLENT	GOOD
Application development	EXCELLENT	GOOD

INTUITIVE FORMS CREATION

Creating forms in Paradox is a straightforward process that gives you total control over their look and feel. The Data Model dialog lets you select the tables to reference in your form and lets you create the relationships between them visually. Joins can also be modified through the Define Link dialog.

After you've selected your data sources, you are presented with a Design Layout dialog where you can make general decisions over the form's look and feel. A preview window displays a form thumbnail to help you decide between single and multirecord layouts or whether data is to be arranged by row or column. You can also start with a blank form.

The product's form designer offers a powerful visual environment where you can intuitively "paint" your form. Using the designer's Speedbar, you can place buttons, graphics, fields, static text, and OLE objects directly onto the form. You can also place crosstab and chart objects to provide detailed analysis of your data. Each element of the form is an object whose properties are accessible through a click of the right mouse button.

Reports are designed by a similar process that also starts with the Data Model dialog. The banded report writer shares a consistent look and feel with the form designer and provides the same set of visual tools. You can add bands to

On the Horizon:

Paradox for Windows 5.0

By Stephen W. Plain

The next upgrade to Paradox for Windows is on the way. When it arrives, possibly by the time you read this, it should include new features aimed at better ease of use, improved functionality, and broader connectivity to SQL databases. The early alpha version of Paradox 5.0 Borland sent us did not implement some of the expected new features, but we were at least able to discern the product's new directions.

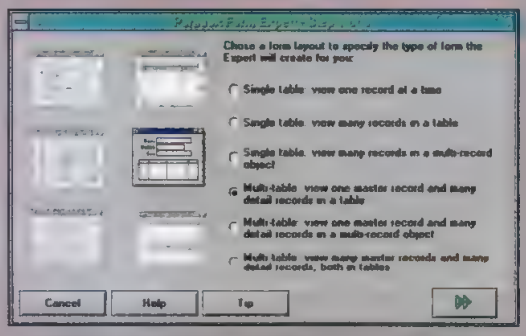
HAND HOLDING

The most obvious improvements will target ease of use. Version 5.0 is slated to include Experts, Borland's equivalent of Microsoft's Wizards, which will guide you through the creation of such database elements as forms, reports, and queries. Our alpha release did not yet have functioning Experts, but we did get a look at some of the screens that will comprise the Form Expert. This Expert will let you choose from several different layouts, including forms, charts, mailing labels, and master-detail forms. In addition, the design layout window has been enhanced to let you preview various stylesheets to select the right look for your form.

Interactive Tutors are also planned for the new Paradox for Windows, which we were able to preview separately from the base product. The tutors hold your hand as you learn to work with elements like queries and reports. In the shipping product, they will be able to intercept your keystrokes and mouse clicks to give you feedback on valid and invalid responses to prompts.

LIVE DATA

One of the most popular features of Microsoft Access is dynasets—dynamic (or editable) result sets from queries. The 5.0 release of Paradox for Windows will provide a similar feature. Currently, results produced by Paradox's powerful query-by-example interface are returned to an answer table that is separate from the source tables they were derived from. Version 5.0 will introduce live, editable queries so that any updates made to the result set will be applied to the source tables. This will be an optional feature; the answer table approach will still be the default. Unfortunately, live editing will only work in queries involving a single table. Version 5.0 will also provide both container and server support for OLE 2.0.



An obvious improvement to Paradox 5.0 is the inclusion of Experts that step you through standard tasks.

A number of other small but welcome tweaks are also in the works. The new version will let you place crosstab objects within reports. Previously, they were only available for use in forms. Several new field types are also being added for Paradox tables including auto-incrementing, date-time, and logical types. Also improved is Paradox's filtering feature: Filters can be applied to fields that do not have a secondary index attached.

The plans for improved SQL connectivity in Version 5.0 will be welcome news for those using Paradox as a front end to remote data. Supported SQL back ends will now include ODBC-compliant databases, Sybase System 10, Oracle7, Informix, and the Express Link component of Borland's Interbase 4.0 product. SQL queries against local data will now be supported as well. There will also be over 200 new ObjectPAL commands for developers.

Individually, these improvements don't add up to an earthshaking transformation of the product. But together they should keep Paradox for Windows firmly in the desktop database race. □

your report to group data on any field, and you can even specify the range of data to allow for that group field. While you can add charts directly to a report, you cannot create crosstab reports. Paradox also lacks dedicated text layout tools, so form letters must be created as banded reports.

APPS CONSTRUCTION

Paradox is a powerful tool for full-blown application development. The programming language, ObjectPAL, is an event-driven version of the PAL (Programming Application Language) used in the DOS version of the product. Each object in a Paradox form has associated methods that serve as handlers for events generated by user actions or the program itself. ObjectPAL code can be attached to these methods to customize the behavior of the associated object.

The Paradox event model is a complex mechanism that passes events through the various object levels and the container form itself. Mastering this system is not an easy task and requires substantial programming aptitude. Getting any automated application off the ground will require some ObjectPAL coding; but used properly, ObjectPAL can be a very powerful resource.

THE WORKGROUP ADVANTAGE

The Workgroup Edition of Paradox for Windows ships with the company's SQL

FACT FILE

Paradox for Windows, Workgroup Edition, Version 4.5

List price: $495.00. **Requires:** 386-based PC or better, 4MB RAM, 20MB hard disk space, Microsoft Windows 3.1 or later. **In short:** Paradox delivers both a usable tool for end users and a rich development platform for programmers. Highlights are its powerful QBE feature, SQL connectivity, and ObjectPAL development language. The learning curve is steep, but Paradox has a platform you're not likely to outgrow. Paradox 5.0, scheduled for release by summer, promises improved ease of use.

Borland International Inc., 100 Borland Way, Scotts Valley, CA 95066-3249, 800-682-9299, 408-431-1000; fax, 408-431-4123.

482 on reader service card

Link drivers that provide direct access to SQL databases from Borland, Microsoft, Oracle, and Sybase. SQL access is totally transparent, and you can query SQL data from the Paradox desktop just as if it were in local tables. You can even create heterogeneous joins between local and remote tables. While these SQL links are a welcome addition to the product, Version 4.5 does not support ODBC-compatible databases.

Also included is the Workgroup Desktop, an integrated module that lets you exchange databases on a LAN or through an e-mail system. The heart of the Workgroup Desktop is Borland's Object Exchange (OBEX) engine. Using OBEX, you can "publish" tables, query results, and sets of files to users who "subscribe" to the information. This can be very useful for distributing periodic revisions of data automatically.

Overall, Paradox for Windows succeeds in pairing a strong relational database with a sophisticated end user interface. If you're willing to do some work to learn the basics, this powerful ad hoc tool leaves you plenty of room to grow.

Symantec Corp.

• Q&A for Windows

BY RICHARD V. DRAGAN

Anyone who has used a spreadsheet successfully should have no trouble using Symantec's Q&A for Windows, Version 4.0. The $249.95 package employs a database-as-spreadsheet metaphor that runs consistently throughout the application, which means even novice users can get a working database up and running quickly.

Such simplicity comes at a price, however. With this flat-file database you'll have to forgo the flexibility and power of a relational data model, and you'll have almost no access to external data sources. Q&A does offer adequate multiuser capabilities, though, so if you need a simple database for an individual or small department, Q&A might be a good choice.

Q&A lets you build queries called retrieve specifications using English-like statements that don't involve programmatical constructs.

BUILDING IN Q&A IS PDQ

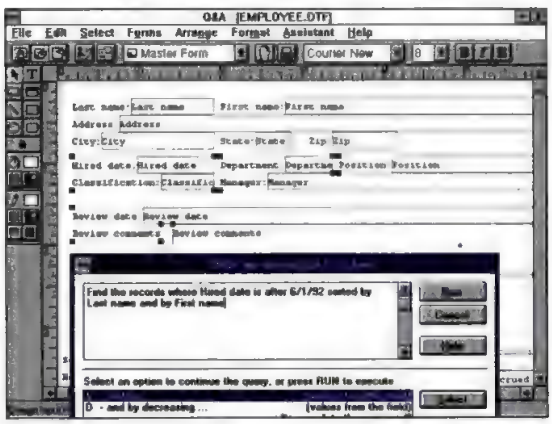
Designing a database in Q&A is as simple as filling in field names and attributes in rows of spreadsheet-like cells, which makes creating and modifying the structure of a database very straightforward. You can easily add and delete fields or change field attributes at any time without endangering live data. Q&A supports eight data types—variable-length text, numeric, currency, date, time, yes/no, picture, and "keyword" (memo)—and you can set field masking and provide initial default values for fields. You can also specify which fields to index in order to speed up searches and even associate custom help text with each field.

To populate your database, you can import existing data from a wide variety of sources, including dBASE, Paradox, Excel, Lotus 1-2-3, comma-delimited, and text files. The import/export options are flexible: You can scan existing data files and then pick and choose which fields to read into your new Q&A database. If you are entering data from scratch, Q&A presents you with a default data entry form, called a master form; you can, of course, also create your own data entry forms. Q&A's WYSIWYG form designer gives you complete control and lets you add text and graphics.

DAVE SPEAKS ENGLISH

You use Q&A's Add/Edit mode to snoop through your database, adding and modifying records or searching on any fields you choose. Querying is made easy by one of Q&A's strongest features, an intelligent assistant called DAVE (for Do Anything Very Easily). Using a guided series of menu selections, DAVE lets you create queries—which Q&A calls retrieve specifications—using English-like statements that don't involve programmatical constructs. For instance, "Find the records where State matches 'NY'" retrieves all the records in a list of clients with addresses in New York. In our tests, Q&A's search times were competitive. To speed up your most common searches, you can index specific fields, though you can always search on any combination of fields (once again, DAVE will help you design a custom sort order).

Creating reports of your data with Q&A is fast and simple. Columnar reports are a snap, thanks to the product's spreadsheet metaphor. Free-form custom reports are also easy to build, and all reports can include calculated fields and summary fields. Q&A provides support for a variety of standard Avery mailing labels, too; simply paste the fields you want to print to a single label and the program takes care of printing a whole sheet



Q&A's claim to fame: Its natural-language query builder lets you use English statements to generate queries.

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- **Operating Environment:** IBM DOS with NetWare from IBM V.3.12 or IBM OS/2 LAN Server 3.0, Entry
- **Prices start at $3,029*** (monitor not included)

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ValuePoint Si Clients (3)

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SUMMARY OF FEATURES CONTINUES

End User Databases

PC MAGAZINE EDITORS' CHOICE

Products listed in alphabetical order ■ = YES □ = NO	Alpha Four, Version 3.0	Approach for Windows, Version 2.1	Approach for Windows, Version 3.0*	DataEase Express for Windows, Version 1.1	FileMaker Pro for Windows, Version 2.1	Microsoft Access, Version 2.0	Paradox for Windows, Work-group Edition, Version 4.5	Q&A for Windows, Version 4.0
List price	$495.00	$395.00	Info not available	$395.00	$399.00	$495.00	$495.00	$249.95
General								
Operating environment	DOS	Windows	Windows	Windows	Windows	Windows	Windows	Windows
File structure:								
Maximum number of characters per text field	256	256	256	255	64,000	255	255	32,767
Maximum number of fields per record	128	255	255	255	Unlimited	255	255	2,048
Maximum record size	5K	4K	4K	4K	Unlimited	2K	5K	64K
Maximum number of records per data file	2 billion	1 billion	1 billion	2 billion	Unlimited	1 billion	1 billion	16 million
Maximum number of files per database	10	10	50	9,999	1	32,768	Unlimited	1
Native file format	dBASE	dBASE	dBASE	DataEase	FileMaker	Access	Paradox	Q&A
Multiple tables per file	□	■	■	□	□	■	□	□
Data types:								
Fixed-length character	■	■	■	■	□	■	■	□
Variable-length character	□	■	■	□	■	□	■	■
Integer	□	■	■	□	□	■	■	□
Floating-point	■	■	■	■	■	■	■	■
Currency	□	■	■	■	■	■	■	■
Date	■	■	■	■	■	■	■	■
Time	□	■	■	■	■	■	□	■
Boolean	■	■	■	■	□	■	■	■
Binary large object (BLOB)	□	□	■	□	■	■	■	■
Field attributes:								
Range testing	■	■	■	■	■	■	■	■
Pattern testing	■	■	■	■	□	■	■	■
Default values	■	■	■	■	■	■	■	■
External data file lookups	■	■	■	■	■	□	■	■
Rule-based verification	■	■	■	■	□	■	■	■
Required field	■	■	■	■	■	■	■	■
Forced uppercase	■	■	■	■	□	■	■	■
Date conversions	■	■	■	□	■	■	■	■
Time conversions	□	■	■	□	■	■	■	■
Unique fields	■	■	■	■	■	■	■	■
Automatically incrementing fields	■	■	■	■	■	■	□	■
Database Access								
Provides connectivity to SQL databases	□	■	■	■	□	■	■	□
Accesses ODBC-compliant databases	□	■	■	■	□	■	□	□
SQL databases supported natively	□	■	■	■	□	■	■	□
Import and export formats supported:								
Comma-delimited ASCII	■	■	■	■	■	■	■	■
Fixed-length ASCII	■	□	■	■	□	■	■	□
User-defined delimiter	■	■	■	■	□	■	■	■
.DB (Paradox)	□	■	■	□	□	■	■	■
.WK* (Lotus 1-2-3)	■	■	■	■	■	■	■	■
dBASE versions supported	III+, IV	III+, IV	III+, IV	III+, IV	III	III+, IV	III+, IV	III, IV
Microsoft Excel versions supported	None	3.0, 4.0	3.0, 4.0	None	None	3.0, 4.0, 5.0	3.0, 4.0	2.1, 3.0, 4.0
Other	Multimate, .PFS (PFS:File), SYLK, Symphony, Visi-Calc, Word Perfect	FoxPro	FoxPro, Lotus Notes	Symphony, Visi-Calc, WordStar	.MRG, SYLK	Btrieve, FoxPro	Quattro Pro	Macintosh
Data Manipulation								
Indexing:								
User can add and delete indexes	■	□	□	■	□	■	■	■
User can enforce unique values	■	■	■	■	■	■	■	■
Indexed values need not be unique	■	■	■	■	■	■	■	■
Input facilities:								
Screen painter	■	■	■	■	■	■	■	■
Calculated fields on entry screens	■	■	■	■	■	■	■	□
Default entry screens	■	■	■	■	■	■	■	■
User-definable entry screens	■	■	■	■	■	■	■	■
Multifile access	■	■	■	■	□	■	■	□

* Expected feature set at press time

SUMMARY OF FEATURES

ENDS

PC MAGAZINE

Products listed in alphabetical order ■ = YES □ = NO	Alpha Four, Version 3.0	Approach for Windows, Version 2.1	Approach for Windows, Version 3.0*	DataEase Express for Windows, Version 1.1	FileMaker Pro for Windows, Version 2.1	Microsoft Access, Version 2.0	Paradox for Windows, Workgroup Edition, Version 4.5	Q&A for Windows, Version 4.0
Data Manipulation (continued)								
Input facilities (continued):								
Multiple record updates	■	■	■	■	□	■	■	□
Multipage screens	■	■	■	■	■	■	■	■
Entry verification	■	■	■	■	■	■	■	■
Query facilities:								
Command line	■	□	□	■	□	■	■	□
Query by form	□	■	■	■	■	□	□	■
Query by example	□	□	■	■	□	■	■	□
Query wizards or experts	□	□	□	□	□	■	■	■
Multiple data file access	■	■	■	■	□	■	■	□
Stored queries	■	■	■	■	■	■	■	■
Macro or scripting language	■	■	■	■	■	■	■	■
Keystroke recorder	■	□	□	□	■	□	□	□
Graphing								
Bar chart	□	□	■	□	□	■	■	□
Line chart	□	□	■	□	□	■	■	□
Pie chart	□	□	■	□	□	■	■	□
Scattergraph	□	□	■	□	□	■	□	□
Stacked bar chart	□	□	■	□	□	■	■	□
High-low-open-close chart	□	□	■	□	□	■	□	□
Other	None	None	Area, 3-D	None	None	Area, doughnut, radar, 3-D	Area, ribbon, 3-D	None
Searching and Sorting								
Search parameters:								
First occurrence	■	■	■	□	■	■	■	□
All occurrences	■	■	■	■	■	■	■	■
Case-sensitive	■	■	■	□	■	□	■	■
Pattern	■	■	■	■	■	■	■	■
Phonetic	■	■	■	■	□	□	□	■
Range	■	■	■	■	■	■	■	■
Whole word	■	■	■	■	■	■	■	■
Wildcard	■	■	■	■	■	■	■	■
Sorting:								
Multikey sort	■	■	■	■	■	■	■	■
Maximum number of sorting levels	5	255	255	255	9	255	255	50
Output Facilities								
WYSIWYG report painter	□	□	■	■	■	■	■	■
Report types:								
Banded	■	■	■	■	■	■	■	■
Columnar	□	■	■	□	■	■	■	■
Cross-tabbed	■	□	■	□	□	■	□	□
Form-based (fixed-length)	■	■	■	■	■	■	■	■
Report definition:								
Multifile access	■	■	■	■	□	■	■	□
Break fields	■	■	■	□	■	■	■	■
Subtotals on breaks	■	■	■	□	■	■	■	■
Totals	■	■	■	■	■	■	■	■
Printing:								
Print preview mode	□	■	■	■	■	■	■	■
PostScript support	■	■	■	■	■	■	■	■
Mail-merge (variable length)	■	■	■	□	■	■	■	■
Standard mailing labels	■	■	■	■	■	■	■	■
Technical Support								
Context-sensitive on-line help	■	□	■	■	■	■	■	■
Telephone support (toll call)	■	■	■	■	■	■	■	■
Free support	60 days	90 days	90 days	10 calls	90 days	None	Setup only	90 days
Other support	Automated phone- and fax-back, AOL, CIS Prodigy, private BBS	Automated phone- and fax-back, CIS, private BBS	Automated phone- and fax-back, CIS, private BBS	CIS, private BBS	900 number; automated phone- and fax-back, AOL, CIS private BBS	CIS, private BBS	900 number automated phone- and fax back, BIX CIS GEnie, private BBS	900 number fax-back AOL CIS, private BBS

* Expected feature set at press time

of labels for you. The use of sliding fields eliminates white space between individual fields for professional-looking output.

Symantec bundles its standalone word processor, Q&A Write, with the database package so you can create mail-merge documents. While Q&A Write does not have all the capabilities of today's most sophisticated word processors, it is a functional addition nonetheless. You can paste database fields from a Q&A database into boilerplate text to create customized mailings, and support for printing envelopes is included as well. What isn't included in the package is any graphing or charting capabilities.

Unfortunately, Q&A offers no SQL access and can only access dBASE data by importing it or through simple lookups.

BEYOND THE BASICS

If you want to update or delete multiple records, you'll need to become familiar with Q&A's scripting language. Over 70 functions are included, with names that any spreadsheet user will recognize. These include support for statistical, date-and-time, string, mathematical, financial, and lookup functions. You can use these functions in formulas to recalculate the value of any or all fields and update those fields in bulk.

Q&A provides a DAVE-like feature, called the Scripting Assistant, to build macro scripts. You can automate any frequently used or repetitive task, such as opening a database, performing a query, sorting the result set, and printing a report. There are other ways to customize the behavior of Q&A, too, such as navigational programming, a feature that lets you move the cursor around a form in response to entered values.

Q&A provides built-in multiuser network capabilities, so with appropriate access rights any user with his or her own copy of Q&A can access a central Q&A database. With Symantec's Network Pack ($499), database administrators can add an additional three users to a Q&A system. Q&A provides automatic record locking, which ensures that multiple users can browse and modify data safely. The package also lets the administrator password-protect particular database functions. Unfortunately, Q&A offers no SQL access and can only access dBASE data by importing it or through simple lookups. Users who need to work with dBASE or client-server databases will have to look elsewhere.

SUITABILITY TO TASK

Q&A for Windows	Power	Ease of Use
Simple database	EXCELLENT	EXCELLENT
Forms and reports	FAIR	EXCELLENT
Query and analysis	FAIR	EXCELLENT
Application development	POOR	GOOD

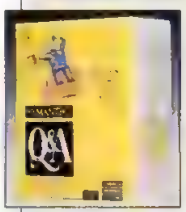
THE CONCLUSION?

Getting a working database up and running quickly is very easy with Q&A. An informative on-line tutorial introduces the central concepts of this application in an hour or two. The user manual is clearly written and provides background material to database basics, and DAVE is always available to help you carry out the most common tasks. Unfortunately, a cloud hangs over this end user database. It is Symantec's policy not to disclose development plans for its products, and while the company has stated that it will continue to support Q&A 4.0, it's not clear if the product will be updated after this version.

For simple tasks—contact management, mailings, and even a small inventory system—the convenience of Symantec's Q&A makes it a functional database solution. If you can live with the constraints of a flat-file database that has no SQL connectivity, Q&A is worth your attention. □

▶ FACT FILE

Q&A for Windows, Version 4.0



List price: $249.95 **Requires:** 386-based PC or better, 4MB RAM, 15MB hard disk space, DOS 3.3 or later, Microsoft Windows 3.1 or later **In short:** Q&A is very easy to use and offers a convenient spreadsheet interface. It also provides guided assistance that uses English-language statements to manage your data. But in the end, its lack of enterprise database connectivity and the limits of its nonrelational flat-file design make it a solution only for standalone databases for individuals and small departments

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First Looks

▶ TCP/IP STACKS

TCP/IP: Much More Than Just the Internet

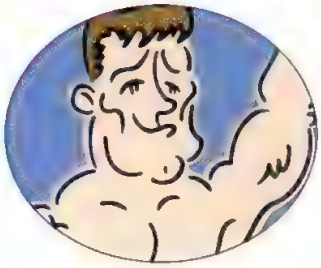
New apps, new interfaces, new versions. We take a look at seven TCP/IP stacks.

By Peter Loshin

Connect or perish: This seems to be the internetworking motto. Either you connect to the Internet and its vast resources or risk being left behind.

There are many ways to link to the Internet. Last issue, we reviewed packages and services *not* based on TCP/IP—with one exception, Mosaic—that put Internet mail and information services within reach using a modem ("Stairway to Data Heaven: Internet Access Tools," June 14, 1994). This issue, we look at seven TCP/IP stacks for the PC. All can work alongside IPX (NetWare) to connect you to the Internet or a TCP/IP network.

Several products in this review are new releases, including our pick for Network Edition Editors' Choice—SuperTCP/NFS for Windows, Version 4.00, from Frontier Technologies Corp. Other new products are NetManage's Chameleon/NFS, Version 4.0; Novell's LAN WorkPlace, Version 4.2 (LAN WorkPlace for DOS, Version 4.01, won *PC Magazine*'s Editors' Choice in "Using the Alphabet Soup," July 1992); and Wollongong's PathWay Series. Three other popular products have impending upgrades—SunSelect's PC-NFS, Version 5.0, will be upgraded to 5.1 by the time this review is published, Beame & Whiteside's (B&W) BW-NFS, Version 3.0c, will advance to Version 3.1,



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Putting Technology

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and FTP Software's PC/TCP, Version 2.3, will be replaced by Version 3.0 and a new product called OnNet.

In addition to these seven vendors, many others are expected to announce TCP/IP packages. Microsoft intends to enter the market by bundling TCP/IP support with Chicago, the highly anticipated new version of Windows. Indeed, it's Microsoft that's spurring many of these vendors to create TCP/IP applications that run across TCP/IP stacks.

FIRST COMES FUNCTIONALITY

When considering a TCP/IP package, first consider its features. The majority of TCP/IP functions—terminal emulation (telnet), file transfer protocol (FTP), and network file sharing through the Network File System (NFS)—are universally and reasonably implemented by every vendor.

However, there are three areas that you might want to consider more carefully: access to e-mail and newsgroups, management facilities, and advanced terminal emulation. E-mail is a crucial function, yet Novell totally omits e-mail readers and SunSelect only offers it as a separate product. If you need to send multimedia messages that can link different file types, you need the Multipurpose Internet Mail Extensions (MIME) standard, which only SuperTCP/NFS and Chameleon/NFS offer.

Access to Usenet news, an international conglomeration of thousands of newsgroups, is also an important Internet-related feature. SuperTCP/NFS and Chameleon/NFS provide access via separate newsreaders, and FTP Software and Wollongong provide e-mail readers, but the others just don't offer access.

A variety of management utilities, in addition to the Simple Network Management Protocol (SNMP), are available within these packages. All include *finger* for getting information about a user of a specific host and *ping* for checking the reachability of remote hosts. Most also include r-utilities (remote utilities), which are quick ways of executing commands. Except for ChameleonNFS, all include *rcp* (remote copy file) and *rsh* (remote shell).

Terminal-emulation differences crop up in the number of emulation types supported, besides the common VT100 provided through telnet. B&W, Novell, and FTP don't offer VT320 emulation, the rest do. If you need Tektronix emulation, Wollongong's PathWay may be the answer—at an additional cost. While all of these products offer IBM mainframe emulation via 3270 emulation, SunSelect offers it as a separate package. If you need 5250 emulation to reach AS/400 systems, Chameleon is your only choice.

Once you've decided on the features you need, consider the type of network you're running. All of the products work with Ethernet or Token-Ring, as well as WAN over serial connections. PathWay and PC/TCP are the only two that include X.25 support; SuperTCP/NFS includes it as an option. And only PC/TCP offers internetworking over AppleTalk. Most of the packages support NetBIOS; Chameleon/NFS is the exception. NetWare is supported by all, and VINES works with PathWay, PC/TCP, Chameleon/NFS, and LAN WorkPlace.

Then consider DOS and Windows functionality. All offer basic DOS functionality except NetManage and SuperTCP/NFS (which offers limited DOS support). Windows solutions can often save you up to 100K.

The key is the software design. Under DOS, network software is usually loaded at start-up as TSRs (terminate and stay resident programs), which communicate with the network when they need to. Network software loaded as DOS TSRs still works under Windows, but it takes a lot of precious low DOS RAM; network software comprising Windows dynamic link libraries (DLLs) or Virtual Device Drivers (VxDs) does not use the low DOS RAM, but it also can't do any networking unless Windows is running. Super-

EDITORS' CHOICE

• SuperTCP/NFS for Windows, Version 4.00

Frontier Technologies Corp.'s SuperTCP/NFS for Windows, Version 4.0, takes the Editors' Choice for the best all-around TCP/IP networking solution for Windows workstations.

Built from the ground up as a Windows application using VxDs to save precious DOS memory, SuperTCP/NFS offers an incredibly complete implementation of a set of protocols originally written for text-based command lines.

SuperTCP/NFS is full of intelligent design features, like automatic sizing of telnet fonts and the ability to manipulate the entire telnet buffer from a pull-down menu. Your mouse works the way you want it to in FTP, pointing and clicking to change default directories and dragging and dropping for copying files across systems. You can still look at raw protocol messages being passed between systems, and you can use a command line interface if you like.

Fast, easy installation and configuration confirm our choice. Also, there is server software that lets you share more than files; your system can offer file, printer, fax, modem, and even e-mail services.

While SuperTCP/NFS features a wide range of IP applications and utilities, including DOS-based versions of telnet, FTP, ping, and the r-utilities, if you need to emulate an IBM 5250 terminal or access IBM PROFS mail services you should look at another DLL-based product—NetManage's Chameleon/NFS.

For DOS networking, take a look at the other packages. Networks with Sun workstations may need SunSelect's PC-NFS. FTP's PC/TCP supports a wide range of networking media other than Ethernet, including DECnet, Banyan's VINES, Token-Ring, and X.25. And Novell's LAN WorkPlace is an adequate all-around TCP/IP solution. Its NetWare support is one of its only assets.

You don't have to blow up your network to have a client/server database.

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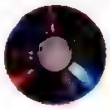

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CIRCLE 926 ON READER SERVICE CARD

TCP/NFS uses VxDs for 32-bit performance under Windows; both FTP Software and B&W have announced VxDs for their next releases. Chameleon/NFS uses DLLs to load and unload network modules in Windows as needed.

The last part of your search should focus on interoperability. You need to see how a product performs on your network. If you find one that works well, buy it. No matter how much better, easier to use, or cheaper the competition is, if it doesn't work on your network, you're wasting time and money. If your decision is split among two or more products then consider ease of use, ease of installation, configuration, support, and price—just some of the key points we look at in this review.

Beame & Whiteside Software Ltd.

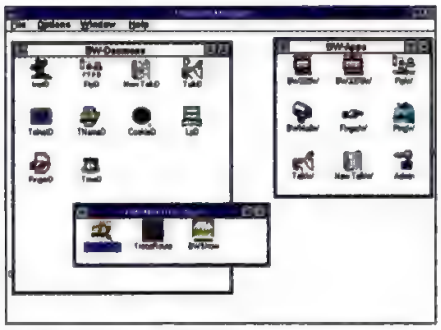
• BW-NFS, Version 3.0c

Integration is the key to Beame & Whiteside's BW-NFS, Version 3.0c. Its proprietary Application Interface Architecture programs allow third-party DOS programs written for FTP's PC/TCP or Novell's LAN WorkPlace to run under it. This TSR program isn't user-friendly, but it does offer interoperability and a variety of network services and functions.

BW-NFS doesn't try to hide its Unix roots: It implements many traditional Unix-flavored tools. Utilities for network backup and troubleshooting are available, as well as many other services. A telnet server allows remote users to connect to your PC for character-based sessions. Only LAN WorkPlace offers a similar function for remote users.

SUITABILITY TO TASK	BW-NFS, Version 3.0c
System management	FAIR
Terminal emulation	FAIR
File transfer	POOR
File sharing	EXCELLENT
Internet connectivity	FAIR

This is not an easy product to install and manage, and it requires a lot of networking knowledge. Program names don't always conform to the generally accepted naming conventions; the telnet program is called bw220 instead of telnet. bw220 does offer file-transfer options during telnet sessions with embedded transfer utilities, but there are no display frills, such as autosized fonts, to ease telnet sessions. In fact, when you change fonts you must resize the window twice in order to get it right.



APPS & MORE APPS: BW-NFS provides a variety of both Windows and DOS utilities.

The Windows version of FTP was disappointing. Only basic FTP commands are supported. On the other hand, the DOS FTP program implements dozens. File sharing is a bright spot, with an excellent NFS interface grafted onto the Windows File Manager that searches the network for connections to NFS servers.

Troubleshooting Internet connections is simplified with troute, a program that traces such connections. E-mail support consists of a quirky Windows mail reader. Usenet news is not supported.

Though BW-NFS, Version 3.0c, fell short of the other packages, a newly announced revision, 3.1 (not shipping at the time of this review), should be worth a look. Version 3.1 promises improved memory management and Windows integration with the VxD architecture. B&W also plans to improve installation, configuration, and application programs.

▶ **BW-NFS, Version 3.0c.** List price: *$349.* Beame & Whiteside Software Ltd., *706 Hillsborough St., Raleigh, NC 27603-1655; 800-463-6637, 919-831-8989.*

Circle 962 on reader service card

NetManage Inc.

• Chameleon/NFS, Version 4.0

The most comprehensive set of Windows network applications in this review is found in NetManage's Chameleon/NFS, were considered bonuses.

SUITABILITY TO TASK	Company Name
System management	POOR
Terminal emulation	FAIR
File transfer	GOOD
File sharing	EXCELLENT
Internet connectivity	EXCELLENT

File transfer Each product provides a different implementation of FTP under Windows, some of which are better than others. Products earning high scores presented an intuitive Windows implementation while offering the full range of FTP functions under Windows.

File sharing The ability to share files through Network File System (NFS) or NetBIOS is important, but file sharing in this way is sometimes a tricky task. High scores went to products with both a good DOS and/or Windows user interface and NetBIOS support.

Internet connectivity Products that integrate easily into internetworks or the Internet share the underlying protocols as well as the user interface programs needed for e-mail, network news, and other services such as Gopher.

Suitability to Task: TCP/IP Stacks

The differences among these products lie in the relative ease of installation and configuration, the simplicity of the interface, and the extent to which additional protocols and programs are implemented. While managers may be more interested in ease of installation and configuration, users look for ease of use.

System management The installation and configuration of TCP/IP software is traditionally difficult. We looked for products that eased this process. We also evaluated whether additional tinkering was necessary after initial installation, the type of memory management used, and total RAM requirements.

Terminal emulation A product's ability to connect the user to remote hosts via telnet was rated based on its GUI features, the breadth of supported terminal emulation types, and its ability to map terminal keyboards easily and logically. Features such as keyboard macros, multiple concurrent sessions, and treatment of buffers

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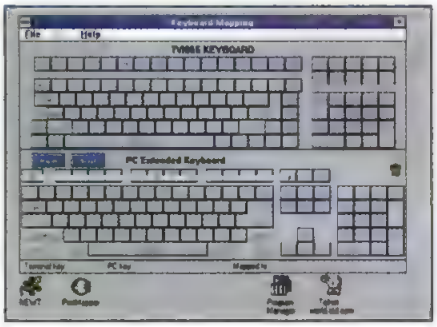
SUMMARY OF FEATURES

TCP/IP Stacks

PC MAGAZINE NETWORK EDITION

Products listed in alphabetical order ■ = YES □ = NO	BW-NFS	Chameleon/NFS	LAN WorkPlace	The PathWay Series	PC-NFS	PC/TCP	SuperTCP/NFS for Windows
List price (per user)	$349	$495	$395	$445	$415	$400	$495
General Features							
Memory management program	TSR	DLL	TSR	TSR	TSR	TSR	VxD
Supports auto-sizing of telnet fonts	□	□	□	■	■	■	■
Provides SNMP agent	■	■	■	■	■	■	■
Supports NetBIOS	■	□	■	■	■	■	■
Supports NIS	■	□	□	□	■	□	□
Mail and News Features							
MIME	□	■	□	□	□	□	■
SMTP	■	■	□	■	Optional	■	■
Mail reader	■	■	□	■	Optional	■	■
NNTP	□	■	□	■	□	■	■
Newsreader	□	■	□	□	□	□	■
Terminal Emulations							
Tektronix	□	□	□	Optional	□	□	□
TN3270	■	■	■	■	Optional	■	■
TN5250	□	■	□	□	□	□	□
VT52	■	■	■	□	■	■	□
VT100, VT101, and VT102	■	■	■	■	■	■	■
VT200 and VT220	■	■	■	■	■	■	■
VT320	□	■	□	■	■	□	■

Version 4.0. Another plus is that NetManage eliminates DOS TSR memory problems by implementing DLLs. Also in its favor are its smooth installation and configuration procedures. Unfortunately, Chameleon/NFS skimps on utilities, and it does not offer remote utilities or NetBIOS support.



PULLING A SWITCH: Chameleon/NFS features full keyboard remapping capabilities with telnet.

NetManage's anticipation of Microsoft's impending entry into the TCP/IP market is evident by the long list of applications—particularly Microsoft applications—with which Chameleon is compatible. Chameleon/NFS was one of only three products that omitted autosized fonts in telnet; the others were BW-NFS and LAN WorkPlace. However, the software does provide a keyboard-mapping utility, and it's the only product that offers 5250 emulation for connecting to IBM AS/400 minicomputers. Its FTP implementation separates file and directory manipulation so both are easier; NFS file sharing is also well-integrated into the Windows File Manager.

SUITABILITY TO TASK Chameleon/NFS, Version 4.0	
System management	EXCELLENT
Terminal emulation	EXCELLENT
File transfer	EXCELLENT
File sharing	GOOD
Internet connectivity	EXCELLENT

Internet connectivity is excellent, consisting of a Usenet newsreader and an e-mail reader that supports multimedia e-mail through the MIME protocol, like SuperTCP/NFS. For accessing PROFS, an IBM Virtual Machine (VM) e-mail system, there's a unique PROFS client. Internet information services can be browsed with a ready-to-run Gopher client; if you want a Gopher client with the other products reviewed here, you'll need to find a third-party client.

▶ **Chameleon/NFS, Version 4.0**. List price: *$495*. NetManage Inc., *10725 N. De-Anza Blvd., Cupertino, CA 95014; 408-973-7171; fax, 408-257-6405.*

Circle 963 on reader service card

Novell Inc.

• LAN WorkPlace, Version 4.2

The word *NetWare* in 2-inch letters on LAN WorkPlace's package should tip you off to Novell's market strategy. NetWare compatibility is a strong selling point. LAN WorkPlace is a TSR with a few nice touches and a lack of Internet support.

The installation and configuration procedures are nice, but there is one slight annoyance: Unlike other products in this roundup, the program references a batch file on start-up that executes the network initialization commands rather than executing commands directly in the AUTOEXEC.BAT file. This can make troubleshooting a little more complicated.

SUITABILITY TO TASK LAN WorkPlace, Version 4.2	
System management	GOOD
Terminal emulation	GOOD
File transfer	EXCELLENT
File sharing	GOOD
Internet connectivity	POOR

Novell's versions of telnet and FTP for Windows are called Host Presenter and Rapid Filer, respectively. Host Presenter has most of the nice GUI touches you'd

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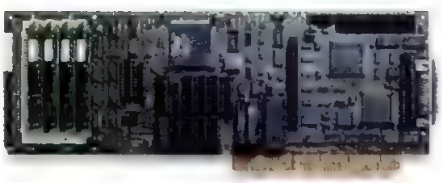

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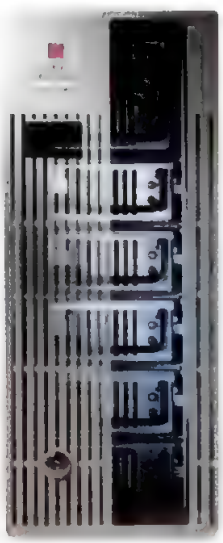

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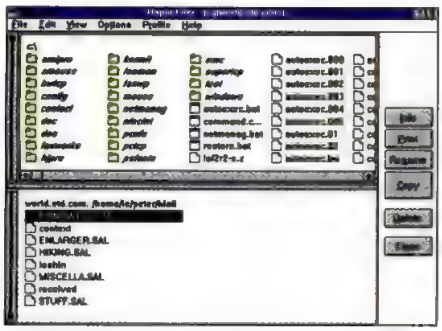

FILES FAST: Rapid Filer is LAN WorkPlace's Windows GUI interpretation of FTP.

expect, like cut-and-paste from terminal sessions and a nice keyboard mapper for the 3270 emulation, but it lacks autosized fonts. Rapid Filer has a nice Windows look and is an effective file-management tool.

LAN WorkPlace offers a method of remote log-in similar to that provided by BW-NFS. LAN WorkPlace uses an X Window client, allowing X or other terminals to log on to a PC and conduct character-based terminal sessions.

Like all of the other packages except PC/TCP, NFS under Windows is managed through the File Manager. Like many of the other packages, it contains no NFS server software for sharing files.

LAN WorkPlace doesn't offer many applications or utilities. Ping and finger are supplemented by r-utilities such as rcp, rexec, and rsh, and some remote printing utilities. IP Resolve is a Windows utility used to identify a host name from an IP address or vice versa.

This product's lack of Internet connectivity is also unique among these products. Altogether, LAN WorkPlace is adequate but uncompelling.

▶ **LAN WorkPlace, Version 4.2.** List price: *$395.* Novell Inc., *122 East 1700 South, Provo, UT 84606-6194; 800-453-1267.*

Circle 964 on reader service card

The Wollongong Group Inc.

• The PathWay Series

Wollongong's TCP/IP networking products are like a set of building blocks: Putting them together depends on what you need. PathWay Access is the application suite that features DOS and Windows versions of telnet, FTP, finger, e-mail and Usenet readers, line printer utilities, and r-utilities. PathWay Runtime, Version 2.0, is the TCP/IP stack that features ping and a network management agent. PathWay Client NFS, Version 2.0.1, provides NFS. Yet another add-on features graphics terminal emulation for Tektronix or IBM 3179 graphics terminals.

SUITABILITY TO TASK The PathWay Series	
System management	GOOD
Terminal emulation	GOOD
File transfer	GOOD
File sharing	EXCELLENT
Internet connectivity	GOOD

The installation and configuration processes were on par with the other packages, but installing the modules was confusing. Even so, PathWay's TSRs have the smallest memory footprint. Wollongong will be introducing a VxD implementation of its stack soon, but since its product is modular, its Windows applica-

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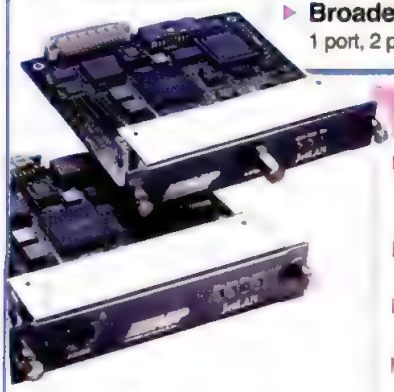

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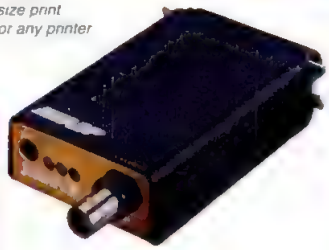

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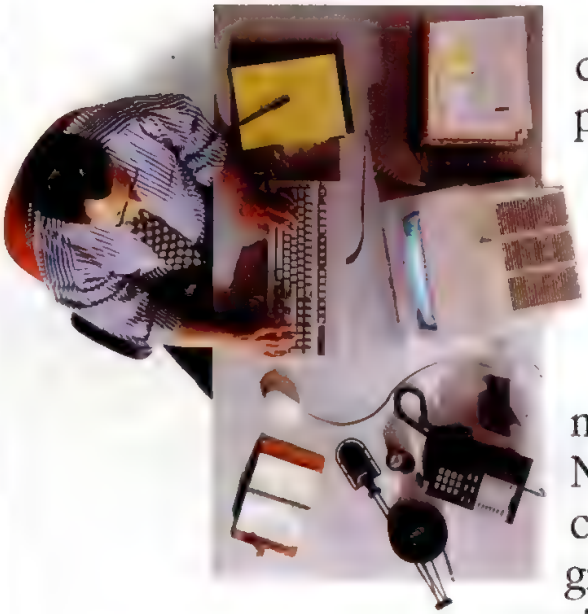

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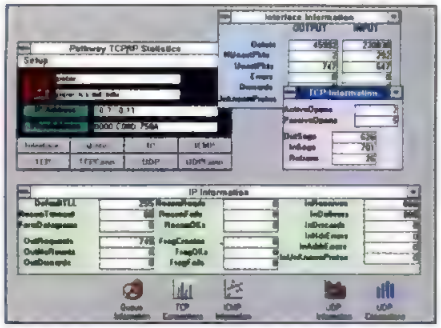
tions will run under other vendors' stacks. The documentation, while thorough, was also difficult to navigate. Like Novell's product, this product contains no master index like those provided in PC/TCP and PC-NFS.

FTP and telnet are both well adapted to the Windows environment but use a rather nondescript toolbar button for opening new connections—it looks like the icon for a generic file. telnet autosizes



TUNE UP: Pathway Access eases network tuning by relating network statistics to the personal workstation.

fonts. FTP shows directories and files in separate, sizable windows. None of the other products offer as much Windows FTP display flexibility.

NFS file sharing is handled quite nicely within the Windows File Manager, with browsing tools to look for NFS servers and exported file systems within each server. Network printer selection is handled through the Control Panel. PathWay also has nice browse features.

E-mail and Usenet news share the mail reader, like PC/TCP, and offer reasonable connectivity to Internet resources. For more expanded e-mail functions, like the ability to run as a mail server and support for extended mail handling protocols X.400 and X.500, you can buy yet another option: Messenger ($195).

▶ **The PathWay Series.** List price: *$445.* **PathWay Access, Version 3.0.** List price: $195. **PathWay Runtime, Version 2.0.** List price: $195. **PathWay Client NFS, Version 2.0.1.** List price: $95. The Wollongong Group Inc., *P.O. Box 51860, 1129 San Antonio Rd., Palo Alto, CA 94303; 800-872-8649.*

Circle 965 on reader service card

Networking Alphabet Soup Glossary

DHCP Dynamic Host Configuration Protocol; A new specification for allocating IP addresses and other configuration information for networked systems based on network adapter addresses.

DNS Domain Name System; A method of translating network host names into addresses.

FTP File Transfer Protocol; A standard protocol for transferring files between computers, usually implemented as an application program.

IP Internet Protocol; The protocol for transmitting blocks of data between hosts. See *TCP/IP.*

NetBIOS Network Basic Input/Output System; A standard PC network interface that allows users to access network devices such as file servers and print servers.

NFS Network File System; A protocol developed by Sun Microsystems that allows computers to share files transparently.

NIS Network Information Services; A set of protocols developed by Sun that identifies hosts and addresses across networks.

ODI Open Data-Link Interface; A Novell driver specification that lets an adapter run multiple protocols.

ping Packet Internet Groper; A program that tests whether a particular host is currently on-line and reachable by sending an echo request and waiting for a reply.

PPP Point-to-Point Protocol; Allows computers to connect to a network over a serial link.

SLIP Serial Line Internet Protocol; Protocol for serial line networking.

SMTP Simple Mail Transfer Protocol; The standard protocol for specifying formats for exchanging e-mail

SNMP Simple Network Management Protocol; A protocol used to monitor devices across the network.

TCP Transmission Control Protocol; The part of TCP/IP that defines the transport-level protocol. See *TCP/IP.*

TCP/IP Transmission Control Protocol/Internet Protocol; A complete suite of Internet Protocol applications and transport protocols, including FTP, telnet, and SMTP.

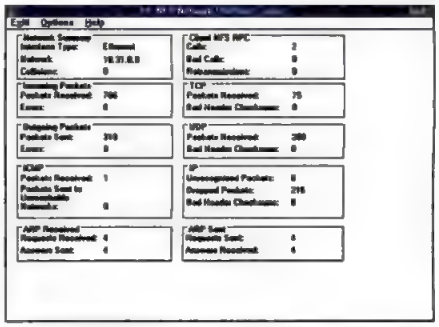
telnet The standard IP protocol for remote-terminal connection.

SunSelect

• PC-NFS, Version 5.0

Compatibility and extensive functionality are guaranteed when you connect to Unix workstation networks with SunSelect's PC-NFS, Version 5.0. Sun developed the NFS standards, as well as the Network Information Services (NIS) protocol and both are well supported by PC-NFS. If you're looking for e-mail support the Select Mail add-on is another $180 and 3270 emulation, which is desirable, is another $240. With these options the total is a hefty $835, about twice the cost of the other packages reviewed.

PC-NFS features include autosized fonts, and a good selection of VT emulations from VT52 through VT320. Special key sequences can be defined with a macro facility, a feature shared by NetManage's Chameleon/NFS and Wollongong's Pathway Access, but PC-NFS lacks a graphical keyboard-mapping tool. File transfer under Windows is unique, sensing FTP servers on the local area network. But PC-NFS breaks with the graphical interface by requiring



STACKS OF STATS: PC-NFS's network statistics program displays network data for troubleshooting a network connection.

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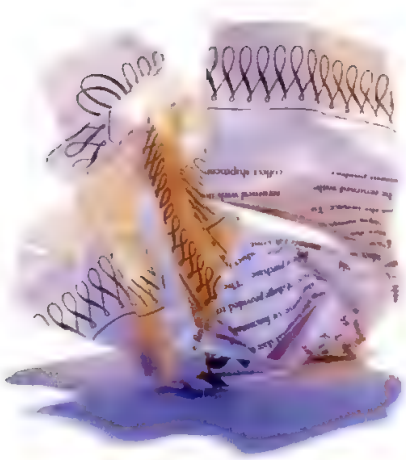

Hewlett-Packard's lifetime warranty excludes power supply and fan assemblies.

3Com's lifetime warranty excludes power supply and fan assemblies.

Asanté's warranty doesn't cover the life of the product.

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Competitive warranty information based on available product warranties April 1994.

CIRCLE 880 ON READER SERVICE CARD

pull-down menus to change directories, unlike the other products in their Windows FTP implementations.

PC-NFS is the only product here to offer a DOS-based NFS mounting tool in addition to the usual Windows' File Manager; both are excellent. On the Internet side, Usenet news is not supported, but e-mail is in a separate package.

Host name conversion to IP addresses (required for name resolution by network applications) is done with the NIS protocol rather than the more widely used Domain Name Service (DNS). PC-NFS is the only product here that doesn't support DNS, but support is planned in release 5.1, along with a new automatic IP address and configuration protocol—Dynamic Host Configuration Protocol (DHCP), which should simplify installation and configuration. PC-NFS, with its options, is expensive, but if you need extra NFS and NIS support it is worth the money.

SUITABILITY TO TASK	
PC-NFS, Version 5.0	
System management	FAIR
Terminal emulation	GOOD
File transfer	GOOD
File sharing	EXCELLENT
Internet connectivity	FAIR

▶ **PC-NFS, Version 5.0.** List price: *$415.* SunSelect, a division of Sun Microsystems, Inc., *2 Elizabeth Dr., Chelmsford, MA 01824-4195; 800-445-8677.*

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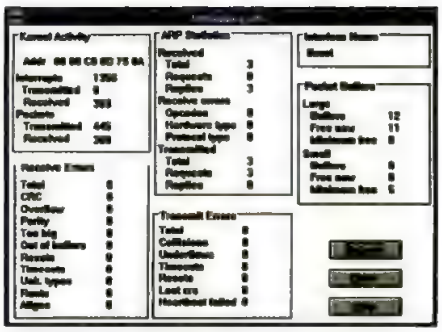
FTP Software Inc.

• PC/TCP, Version 2.3

FTP Software's PC/TCP, Version 2.3, offers the broadest implementation of TCP/IP applications, utilities, and protocols across network environments. It is the package that can run on a LocalTalk network, and one of three that offer WAN support through the X.25 protocol. Its breadth is complemented by some unique applications such as remote tape mounting and Kerberos, an authentication service that provides a solution to remote utility and NFS security holes.

Chances are you'll be able to use PC/TCP in your network environment, whether it's Novell's NetWare, Banyan's VINES, or even DECnet—providing you're able to install and configure it. The Quick Install Guide is 10 pages long; the Installation Guide is almost 100 pages long. Loading the network TSRs is simple, and you can direct them to load high or low in a configuration procedure, bypassing memory management programs, but they are memory intensive. PC/TCP is not for the computer novice, and it can be taxing even to the network expert. It was the only pack-



WHAT'S UP: PC/TCP's WINET features debugging data for troubleshooting your network.

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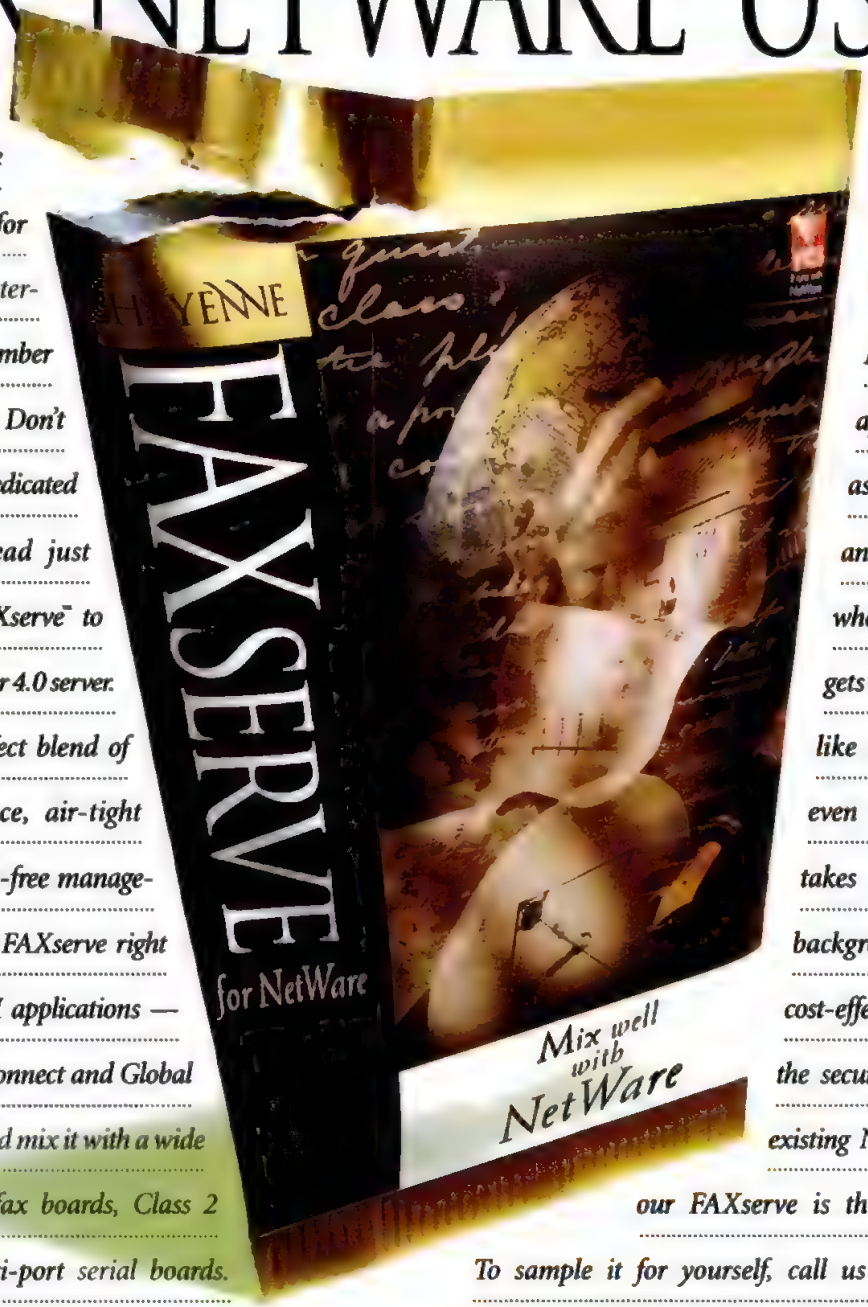
INSTANT FAXING FOR NETWARE USERS.

If you're ready for computer-based faxing, remember our simple recipe. Don't bother adding a dedicated workstation; instead just add Cheyenne FAXserve™ to any NetWare 3.1X or 4.0 server. Then enjoy a perfect blend of robust performance, air-tight security, and hassle-free management. You can stir FAXserve right in with other NLM applications — such as NetWare Connect and Global MHS E-mail — and mix it with a wide range of certified fax boards, Class 2 modems and multi-port serial boards.



With FAXserve, users can fax from within any DOS, Windows, or MHS E-Mail-compliant application. It's as easy as preparing a document and defining who gets it, where it goes, and when it gets sent. Everything else — like monitoring, queuing, even automatic redialing — takes place entirely in the background. So for simple, cost-effective fax services within the secure environment of your existing Novell operating system, our FAXserve is the essential ingredient.

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CIRCLE 868 ON READER SERVICE CARD

age that didn't install properly for us the first time around.

The good news is that a new release (3.0) and a new package, OnNet (the VxD implementation of 3.0), should offer improved installation and configuration and more advanced network tools.

PC/TCP, Version 2.3, features the most r-utilities of any of the products reviewed, as well as a wide variety of other network utilities, including inet for network tuning and troubleshooting and nicname for getting user and host name information from the Network Information Center.

The Windows telnet program features autosizing of fonts and a graphical keyboard-remapping tool. File transfer with FTP is reasonably implemented, though file and directory manipulation are not as easy as they could be. File sharing over NFS uses FTP's InterDrive program. Mounting and unmounting remote file systems is done separately through a PC/TCP Network Control icon, unlike the other packages here, which use Windows File Manager as an interface. Internet connectivity with e-mail and Usenet news is good, though both functions are performed by the basic e-mail reader.

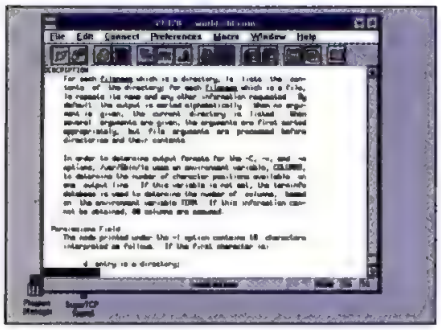
SUITABILITY TO TASK	PC/TCP, Version 2.3
System management	POOR
Terminal emulation	GOOD
File transfer	GOOD
File sharing	GOOD
Internet connectivity	GOOD

▶ **PC/TCP, Version 2.3.** List price: *$400.* FTP Software, Inc., *2 High St., North Andover, MA 01845-2620; 800-282-4387.*
Circle 968 on reader service card

Frontier Technologies Corp.

• SuperTCP/NFS for Windows, Version 4.00

Frontier Technologies Corp.'s SuperTCP/NFS for Windows, Version 4.00, starts off right by eliminating DOS memory problems: It implements the VxD architecture and loads it into expanded memory under Windows. It also features a large selection of TCP/IP applications, as well as DOS versions of the most basic TCP/IP applications such as telnet, FTP, and r-utilities like rcp, rexec, and rsh, for the best of both worlds. Frontier hopes to capitalize on its extensive set of applications by offering interoperability with other vendors' TCP/IP stacks (most notably Microsoft's long-awaited Chicago).



SCROLLING AROUND: SuperTCP/NFS's telnet allows you to manipulate the buffer so data isn't lost when it scrolls up and off the screen.

SuperTCP/NFS earned its Editors' Choice with features like its unique 32-bit VxD architecture, its ease of installation and configuration, its comprehensive set of applications, which include software for network sharing of files, printers, modems, and even fax machines, and for a generally well-designed set of graphical interpretations for standard network applications such as FTP and telnet.

Configuration is a breeze using the SetupTCP program: Icons for all client and server software scroll in a window on the left of the screen and configuration parameters are entered on the right. Telnet implementation is outstanding: Fonts adapt to the size of the telnet window, display options and session-logging options are accessible in a button bar, and keyboard mapping uses an image of a keyboard.

FTP functions include the ability to enter FTP commands directly and to view the protocol messages relating to the current session. File sharing with NFS is nicely integrated into the Windows File Manager and hosts providing NFS services can be browsed efficiently. Also unique is the ability to offer NFS file services to other systems on the network.

SUITABILITY TO TASK	SuperTCP/NFS for Windows, Version 4.00
System management	EXCELLENT
Terminal emulation	EXCELLENT
File transfer	EXCELLENT
File sharing	EXCELLENT
Internet connectivity	GOOD

Separate e-mail and Usenet news readers integrate you into the Internet, and multimedia e-mail is supported through MIME. Clients for newer Internet information services such as Gopher are not available yet, but they will be soon.

▶ **SuperTCP/NFS for Windows, Version 4.00.** List price: *$495.* Frontier Technologies Corp., *10201 N. Port Washington Rd., 13 West, Mequon, WI 53092; 414-241-4555.*
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Peter Loshin is a network consultant.

▶ NETWARE/NT INTEGRATION

The NT Door Opens for NetWare Clients

BY JEFFREY D. BAHER

Beame & Whiteside's BW-MultiConnect for Windows NT provides the simplest solution yet for a growing problem: how to integrate Windows NT servers into a NetWare LAN. It isn't the only method currently available, but it is the only one that doesn't require extensive modifications to every client.

Until now, the only way to integrate the two was to load a protocol stack—NetBEUI or TCP /IP—on every NetWare client, which can be a management hassle, consumes client memory, and incurs the cost associated with troubleshooting an additional protocol.

BW-MultiConnect (priced from about $850 to $9,700) is the first IPX-based product on the market to integrate the two platforms.

With MultiConnect, you only need to load an IPX/SPX stack on the NT server. The NetWare clients remain unchanged and, as such, you will need to spend less time managing and troubleshooting the network.

There are several reasons for running a Windows NT server in a NetWare environment, not least of which is NT's multiprocessing support (which NetWare does not yet offer).

Continues on page NE27

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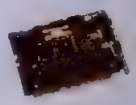

Most network adapter suppliers look alike. But when you take a close look, there's only one king. Eagle Technology. Anything less is just that.

For product information or the name of the Eagle reseller nearest you, call 1-800-52-4EAGL.

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NT for NetWare

CONTINUED FROM NE25

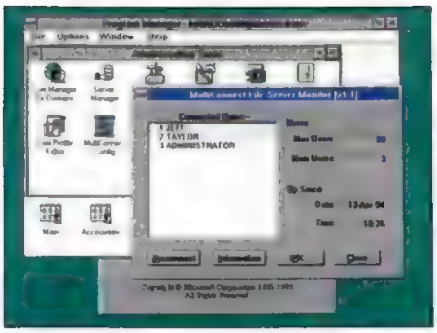
Will Microsoft and Novell offer alternative ways to integrate Windows NT with NetWare? Sure, but both vendors plan to provide requesters, which will give Windows NT clients access to NetWare servers, not allow NetWare clients to access Windows NT servers.

MultiConnect comprises two components: the company's implementation of the IPX protocol (BWS_ipx) and the network file and print server (BWS_NW_Server). Both components can be installed easily on an NT server. BWS_ipx works much like Microsoft's NWLINK, the utility that allows IPX/SPX to communicate with a network adapter driver compliant with the Network Driver Interface Specification (NDIS). Additionally, BWS_ipx handles the routing of IPX packets and supports all common Ethernet and Token-Ring frame types.

BWS_NW_Server works in conjunction with BWS_ipx to extend Windows NT file and print services to NetWare clients. BWS_NW_Server makes an NT server look and feel like a NetWare 3.1x file server. All of the important NetWare features, such as Bindery services, print queue management, and support for multiple concurrent client sessions, are available.

BW-MultiConnect is particularly useful in those NetWare sites that want to take advantage of NT's multiprocessing capabilities for running CPU-intensive applications such as Sybase's SQL Server for NetWare. We found it simple to use BW-MultiConnect to integrate NT servers into a NetWare-based SQL Server database. We also found it easy to connect an entire NT network to our NetWare environment.

BW-MultiConnect requires a minimal amount of configuration to operate.



SMOOTH INTEGRATION: BW-MultiConnect lets NetWare clients attach to NT servers.

During installation, you enter all the necessary information in a single window. BW-MultiConnect's documentation is very helpful for defining the NetWare parameters for the NT server, including assigning a file server name and specifying the network adapters that are being used.

We ran into a few problems during our tests: We could not use the NetWare attach command to connect to the NT server after logging in to NetWare. Similarly, we could not attach to a NetWare server after logging in to the NT server. The problem arose from the fact that the attach command sends encrypted account information and neither platform supports the other's encrypted data formats. Fortunately, BW-MultiConnect comes with customized attach and login commands that bypass the problem.

Despite the snags, BW-MultiConnect for Windows NT is an excellent method of integrating two powerful environments. It is easy to install and configure, and it brings the power of NT to NetWare without the need for new client protocols.

▶ **BW-MultiConnect, Version 1.1.** List price: *5-user license, $849; unlimited license, $9,695.* Beame & Whiteside Software Ltd., *706 Hillsborough St., Raleigh, NC 27603-1655; 919-831-8989; fax, 919-831-8990.*

Circle 960 on reader service card

Integrating NetWare and Windows NT

Solution	Pros	Cons
Installing BW MultiConnect for Windows NT	• Uses a single network protocol (IPX) • Requires limited changes at clients	• Provides only file and print services • Does not support Windows NT administration features
Loading NetBEUI on all clients	• Allows compatibility not only with Windows NT but also with Microsoft Windows for Workgroups, LAN Manager, and LAN Server	• Requires a second network protocol • Is a nonroutable protocol
Loading TCP/IP on all clients	• Widely supported protocol allows compatibility with most networks and the Internet	• Requires a second network protocol • Requires unique IP address for each client

VB Power

ISBN: 1-56276-073-4
Price: $34.95

This innovative guide by Dan Appleman turns Visual Basic programmers into power users by illuminating the tools of the Windows Application Program Interface (API). Includes a time-saving disk that contains source code from the examples in the text, plus a specially designed dynamic link library (DLL).

Available at fine bookstores, or call 1-800-688-0448 ext. 8448

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▶ LOTUS NOTES APPLICATIONS

Paging All Mobile Notes Users

BY PADRAIC BOYLE

Constant connectivity is here for Notes users: Lotus' new Lotus Notes Pager Gateway ($995) allows users to receive Notes e-mail and other messages with a SkyTel SkyWord alphanumeric pager. The communication is only one-way and the messages are limited to 240 characters, but even with those limitations the Pager Gateway is a great way to stay in touch with the office.

There are no other products on the market today that work directly with Lotus Notes to allow communications to pagers. However, SkyTel does offer similar wireless communications for Motorola's SiteConnect Server, which works with WordPerfect Office, as well as OfficeVision/400, for e-mail connections from IBM AS/400s.

You can install the Pager Gateway software easily with the help of a fully automated setup routine. Once installed, it allows Notes users to compose a message and address it to a SkyTel recipient. Notes macros support filtering and forwarding of e-mail to the pager based on subject, sender, priority, or content.

The Pager Gateway can also be used with Notes' many other groupware features. For example, the latest data in a sales or accounting database can be sent through the gateway.

As they pass through the gateway, Notes messages are formatted to be compatible with SkyTel's SkyWord Access program. The message is then sent to the SkyTel main system and forwarded to the pager. The Notes e-mail system allows you to request a receipt, but this feature did not prove very useful during our tests: It only indicated that the message had been passed to SkyTel and not that the recipient had actually gotten the message.

Besides the initial charge for the gateway, users will be charged for access to the SkyTel system according to the number of characters sent in each message. Ironically, the 240-character limit could save you money by keeping down the SkyTel charges.

The Lotus Notes Pager Gateway is an excellent new tool for Notes users on the move. Despite the message-size limitations and the one-way access, the Pager Gateway brings a level of convenience and flexibility to electronic messaging that Notes users are sure to appreciate.□

▶ **Lotus Notes Pager Gateway.** List price: *$995.* Lotus Development Corp., *55 Cambridge Pkwy., Cambridge, MA 02142; 800-343-5414; fax, 617-693-3512.*

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Comfortably add users while you mix and match Windows and DOS. As you grow, enjoy true peer-to-peer and client/server flexibility in any combination.

Strongest Peer Platform
POWERLan's multi-tasking, dedicated server provides the capacity and horsepower for your performance-critical applications.

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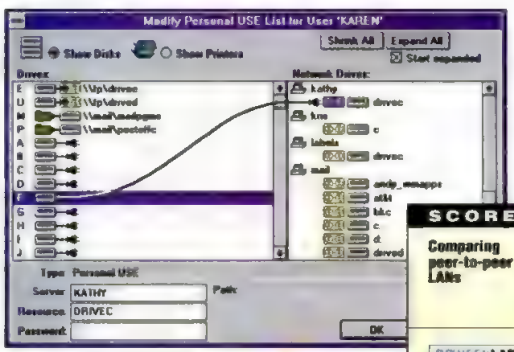
Superior user and group handling, single-logon to the entire network, remote admin, and mainframe-style printing—all contribute to POWERLan's easy setup and administration for small or large sites.



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PC Week
February 7, 1994

SCOREBOARD

Comparing peer-to-peer LANs	Artisoft Inc. Simply LANtastic 5.1	Microsoft Corp. Windows for Workgroups 3.11	Novell Inc. Personal NetWare 1.1	Performance Technology Inc. PowerLan 3.0 for Windows
PCWEEK LABS Overall score	3.2	3.5	3.5	4.0

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PERFORMANCE TECHNOLOGY

CIRCLE 867 ON READER SERVICE CARD

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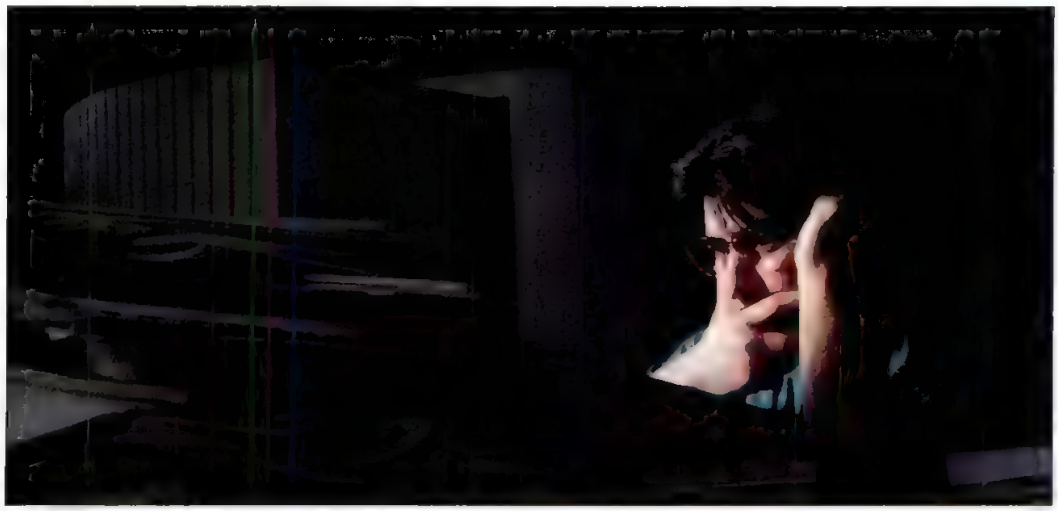

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▶ NETWARE UTILITIES

NodeInfo Solves a Fundamental Problem

BY STEVE RIGNEY

The ability to track network connections and file usage is so important, it's amazing that there aren't hundreds of applications on the market for performing these basic tasks. In fact, there's only one. Avanti Technology's DOS-based NodeInfo, Version 1.25 ($95 per site or $395 for a multisite corporate license) allows you to monitor connections and file usage on NetWare networks quickly and easily.

While NetWare provides the ability for you to discover exactly who is connected to the network and which resources they are using at any given time, you have to use several different utilities and navigate a myriad of menus to gather all the information. If you want to take some sort of action, such as disconnect a user or broadcast a message, you'll find yourself confronted with even more utilities and menus.

NodeInfo, which can run on any NetWare client, allows you to monitor all of your network users and locate open files by searching by user name, NetWare group name, or network address from a single screen. Additionally, NodeInfo allows you to broadcast network messages and clear individual connections by logging a user out of a given file server. It combines the best connection management features of NetWare's Fconsole, Rconsole, and Monitor programs into one easy-to-use, relatively inexpensive utility program.

The NodeInfo main screen lets you monitor how many users are connected to your file server. Individual user connections are represented by smiley faces, asterisks, or circles. When you select one of the users, a window opens displaying that user's open files, node address, disk space usage, service requests, login time, and read/write usage for the current session. You can also highlight multiple users and broadcast a message to them all or clear their connections. While the NetWare Fconsole and Monitor utilities will perform the same tasks, you cannot use the NetWare utilities to select several users and perform a multiple broadcast or clear several connections with a single keystroke.

NodeInfo also provides a command-line interface that you can use to create batch processes, which are automated tasks launched by a DOS batch file. In our tests, we used the command-line syntax to find all users accessing a particular file, broadcast a message to those users for a period of 5 minutes, and sever their connections after that time. The NodeInfo batch-processing commands are ideal for clearing all network connections before making a daily backup, rebuilding an e-mail database, or performing any other job that requires access to several network files.

SMILEY FACES OR MENU BOXES? Even though it isn't a fancy Windows utility, NodeInfo (top) provides a variety of connection information in a way that is much easier to read than NetWare's Fconsole (bottom).

Avanti Technology also includes a separate NetWare Loadable Module (NLM) for registered users that works with NodeInfo and grants NetWare clients limited access to the information NodeInfo monitors. This allows a client to determine who has a particular file open and send a message to that person (most often a request to close the file in question). The limited access provided by the NLM only allows users to monitor—not delete or clear—another user's connection. The same task in NetWare would require you to give every user Fconsole privileges; the users could in turn delete connections and wreak havoc at will.

NodeInfo is shipped on a low-density disk and does not include any manuals or an installation program. In order to get the product up and running, you have to copy the NodeInfo files to a directory manually and then run the NodeInfo program. It's not the most intuitive system, but it only took us a few minutes to get everything loaded and configured.

NodeInfo is strictly a DOS-based application, but Avanti provides a Windows .PIF file and icon, which somewhat simplify the task of setting up NodeInfo to run in a DOS box under Windows. While NodeInfo is very easy to use and offers excellent context-sensitive help, a manual would be nice, especially to help you learn how to create the batch jobs.

The simplicity of NodeInfo is amazing; the fact that it is the only application of its kind is doubly so. On a 10- to 20-user NetWare LAN, the network operating system's built-in utilities may suffice to monitor and control network connections. But for only $95, NodeInfo's connection-monitoring features are a bargain for any LAN—large or small.

▶ **NodeInfo, Version 1.25.** List price: *$95 per site, $395 per corporate license.* Avanti Technology Inc., *13492 Research Blvd., #120-271, Austin, TX 78750; 512-335-1168; fax, 512-335-7838.*

Circle 961 on reader service card

Network Edition

NEW & IMPROVED

News of announced network products and upgrades

By Vicki B. Jacobson

IMPROVED

Banyan Brings Messaging to More Users and Applications

Banyan Systems strengthens its electronic messaging platform with enhancements to Intelligent Messaging III. Besides newly added support for the company's BeyondMail, Version 2.0, Intelligent Messaging now features support for multiple mail-based and mail-enabled applications, including document sharing, workflow, electronic forms, and scheduling.

Like Banyan's StreetTalk III directory service, Intelligent Messaging III now implements message attributes, allowing the user to assign specific characteristics to an address.

Banyan also stepped up its monitoring and management capabilities with the addition of system-generated alerts that can recognize significant events such as low disk space, communications failures, or performance problems. Release III also allows users to monitor Intelligent Messaging from their SNMP-based management stations.

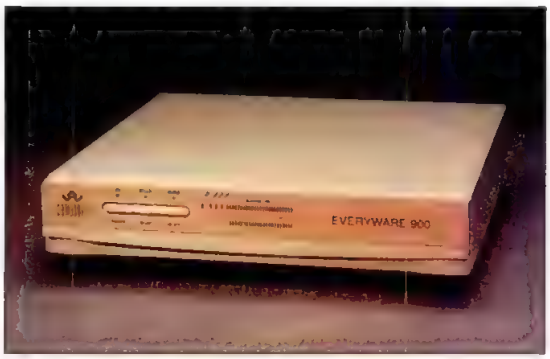
▶ **Intelligent Messaging III.** List price: *$1,495 per server.* Banyan Systems Inc., *120 Flanders Rd., Westboro, MA 01581; 508-898-1000.*

Circle 951 on reader service card

NEW

Remote Access Goes Everyware

With ISDN becoming more widely accepted and standardized, **Combinet** targets remote users with two new ISDN products: the Everyware SOHO (Small Office/Home Office) On-Demand Bridge for home and remote users and the Everyware 900 On-Demand Access Server for managing hundreds of remote users.



ISDN ON DEMAND: Everyware 900 provides high-speed access to the LAN from remote sites.

Everyware SOHO brings ISDN-BRI (basic-rate interface) bridging to home and remote offices that have more than one desktop. The bridge connects up to four devices at 128 Kbps per device. SOHO also features the Point-to-Point Protocol (PPP) for interoperability with other vendors' bridges. It is compatible with Ethernet LANs as well as PCs, Macs, workstations, and X-terminals. NOS support includes NetWare, Sun, LAN Manager, and VINES.

Combinet claims to have halved the cost of ISDN bridging with the Everyware 900. The server can accommodate up to 1,000 users and features ISDN-PRI (primary-rate interface) bridging and IP routing capabilities, centralized management, 4:1 data compression, SNMP remote management, and security features.

▶ **Everyware 900 On-Demand Access Server.** List price: *$4,990.* **Everyware SOHO On-Demand Bridge.** List price: *$1,190.* Combinet Inc., *333 W. El Camino Real, Sunnyvale, CA 94087; 800-967-6651, 408-522-9020; fax, 408-732-5479.*

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HOT PROSPECT

IMA Brings You Messaging Via MIME

Internet Exchange for cc:Mail from **International Messaging Associates** lets cc:Mail users transfer data (text, graphics, and sound, for example) over the Internet. The new software implements Multipurpose Internet Mail Extensions (MIME), making it one of the first cc:Mail-to-SMTP (Simple Mail Transfer Protocol) gateways to support the standard. MIME, which is an extension of the SMTP protocol, is a relatively new standard that was designed for transferring textual and nontextual data over the Internet.

The software features multitasking: Messages can be simultaneously encoded, decoded, sent, and received. Internet Exchange for cc:Mail, Version 1.0, uses any combination of Domain Naming System, host table, and default host-based routing. This allows the gateway software to function as an Internet mail router.

▶ **Internet Exchange for cc:Mail, Version 1.0.** List price: *$3,395.* International Messaging Associates, *139 Mitchell Ave., #102, South San Francisco, CA 94080; 415-871-4045; fax, 415-871-7392.*

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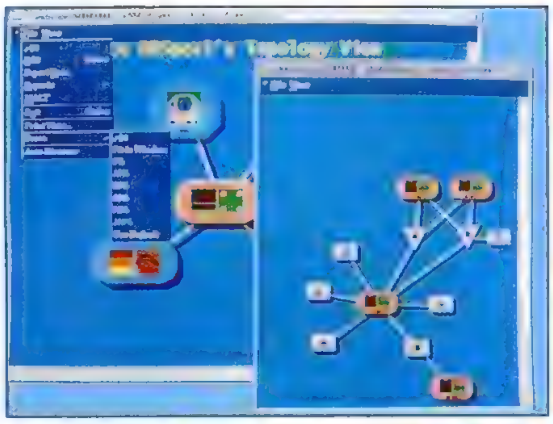
IMPROVED

Multiple Users Share Database



CROSSING THE LINE: Spectrum, Version 3.0, extends its reach to WANs.

Cabletron's latest release of its network management platform, Spectrum, extends the product's reach to WANs, telephony and PBX management, and ATM- and connection-oriented systems. At remote or central sites, users can share a network-management database.

Spectrum, Version 3.0, is based on a client/server architecture, and it uses distributed databases called SpectroServers. These SpectroServers contain working models of every device, created by Spectrum using collected real-time data. Spectrum uses polling, threshold monitoring, alarm notification, and fault isolation.

▶ **Spectrum, Version 3.0.** List price: *$15,000.* Cabletron Systems Inc., *36 Industrial Way, Rochester, NH 03867-5005; 603-332-9400.*

Circle 953 on reader service card

NEW

Xedia Wants Switch Users to Get MAD

Xedia Corp. cuts the cost of Ethernet switches with its MADway Series. At about $400 per switched port (down from typical costs of from $700 to $1,000), the series allows users to boost throughput while supporting 100-Mbps technologies.

MADswitch is a stackable Ethernet switch that supports up to six segments and features an expansion slot for 100-Mbps technologies, as well as the Spanning Tree protocol. MADswitch/PC is a PC card Ethernet switch that includes a NetWare 3.1*x* ODI driver and SNMP-based management. MADremote is an ISDN remote Ethernet switch that extends a switched segment across a WAN to remote sites. The SNMP-based switch supports four 64-Kbps ISDN B channels.

▶ **MADswitch.** List price: *$2,995.* **MADswitch/PC.** List price: *$2,695.* **MADremote.** List price: *$2,995.* Xedia Corp., *301 Ballardville St., Wilmington, MA 01887; 800-989-3341, 508-658-7200; fax, 508-658-7204.*

Circle 954 on reader service card

NEW

Isocor Furthers Windows and Unix Connectivity

New messaging products from **Isocor** bring PC and Unix users closer together. Mapiware uses MAPI (Microsoft Windows Messaging API) instead of a gateway or protocol converter to interconnect PC-compatible and Unix-based computers with enterprise-wide messaging systems and public networks.

MCI Mail, AT&T Mail, CompuServe, X.400, and Internet users (among others) can exchange e-mail, text, graphics, audio, and video without having to customize messages to the delivery format. Mapiware works over a variety of links and a variety of remote connections.

▶ **Mapiware.** List price: *$50 to $500 (depending upon options and volume).* Isocor, *12011 San Vicente Blvd., Los Angeles, CA 90049; 310-476-2671; fax, 310-472-1055.*

Circle 955 on reader service card

BRIEFS

ROUTERS

Cayman Systems provides a connection between workgroups and an Ethernet backbone with its GatorRoute iR ($3,295), which features two Ethernet ports and two expansion slots for either two serial ports or one serial and one LocalTalk port. It can simultaneously route AppleTalk, IPX, TCP/IP, and DECnet. 617-932-1100.

CrossComm Corp.'s XL Integrated Branch Node (IBN) integrates six functions: router, hub, data service unit/channel service unit, compression unit, SDLC-LLC converter (Synchronous Data Link Control and Logical Link Control are data link–level protocols), and RMON agent/probe . The XL IBN ($5,995) provides a connection between branch offices and a central site. It features one LAN, two WAN, and one dial back-up port. 508-481-4060.

BRIDGES

IBM's new 8229 Bridge ($3,495), a replacement for its 8209 Token-Ring to Ethernet Bridge, offers users a choice of connections: two local Token-Ring segments, a local Token-Ring with a local Ethernet segment, or two remote Token-Ring segments. The bridge can be managed by both the IBM LAN Network Manager and an SNMP Manager. 919-543-5007.

Xyplex Inc. developed a new bridge/router module for its Network 9000 Routing Hub that provides a path from Ethernet to ATM. The 520 ATM module ($8,995) allows 10BaseT ports to connect to ATM and has two components: a 520 hot-swappable input/output module and a 401 bridge/router processor module. 508-264-9900.

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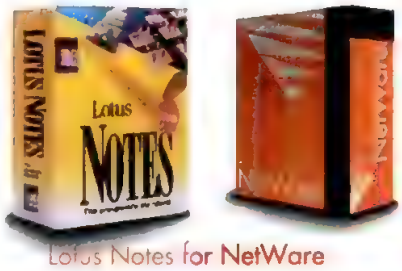

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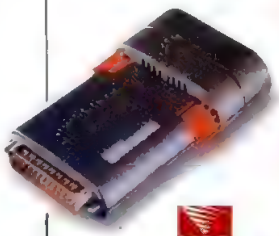

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Network Edition TECHNOLOGY SPOTLIGHT

A Realistic Multimedia Migration Path

Isochronous Ethernet will ease the integration of voice and video into LANs.

By Salvatore Salamone

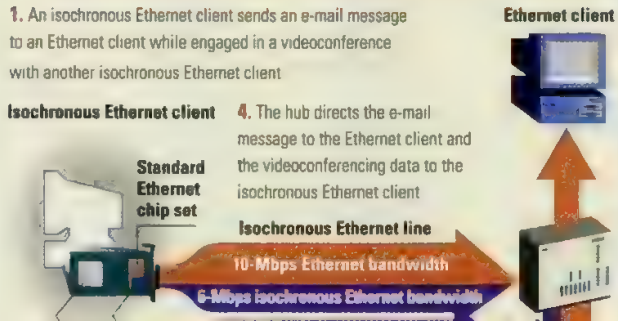
It's inevitable: Sooner or later you're going to have to upgrade your network to accommodate voice and video. Several technologies, such as asynchronous transfer mode (ATM), promise to help you with this endeavor, but they are either too expensive to implement or require extensive network retooling. Enter the proposed isochronous Ethernet standard, or IEEE 802.9a: an extension to the Ethernet standard that will let you enhance a 10BaseT network's ability to support voice, video, and other time-sensitive data types with additional bandwidth.

Isochronous Ethernet was proposed by Apple, IBM, and National Semiconductor in 1992. It will add 6 Mbps of bandwidth to Ethernet networks, which would then be dedicated to bandline multime-

ware applications. Access to the extra bandwidth will be transparent.

The additional 6-Mbps channel will provide the equivalent of 96 ISDN B channels, each running at 64 Kbps. To put that kind of bandwidth in perspective, most high-end videoconferencing systems require six 64-Kbps lines. Lower-end videoconferencing systems typically use two 64-Kbps lines. This means that an isochronous Ethernet network will be able to sustain between 15 and 40 video-

Multimedia Passing Lane



These hubs will also handle regular Ethernet data in the same way a standard Ethernet hub would. This will allow isochronous Ethernet clients attached to this hub to run multimedia applications and exchange voice and video. Additionally, these clients will be able to access Ethernet resources and clients normally. Isochronous Ethernet clients will not be able to send isochronous data to Ethernet clients.

To extend isochronous Ethernet connections over the WAN, a *multiplexer* (which is used to pass multiple signals over a single line) or CSU/DSU (which provides connections to digital lines) establishes the connection to an ISDN, T1, or Switched 56 line. As with any WAN connection, the quality of video (or other multimedia data type) will depend on the amount of available bandwidth. For example, if isochronous Ethernet's full bandwidth is available over 96 ISDN lines, three or four individuals could utilize a conferencing application with very good resolution and performance. If only two ISDN lines are used, the same users would see a drop in image size, resolution, and video refresh rate.

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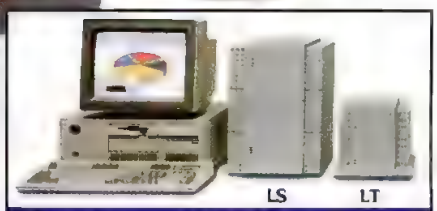

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LAN TIMES READERS CHOICE 1993

MICROPOLIS®

The Wiring Hub Metamorphosis

By Nick Lippis

Everybody likes an underdog. Just look at the success of the *Rocky* movies. And if Sly Stallone were an internetworking vendor, he'd be one of today's hub leaders—3Com or HP. Yup, you heard it right: The reign of SynOptics, Cabletron, and Ungermann-Bass is nearly over. 3Com and HP are now the hub leaders to look toward for strategic and market direction. Here's why.

3Com and HP were the first vendors to position themselves in the fastest growing segment of the hub market—stackable hubs. Chassis hubs, as you'll recall, have dominated the hub market in general—and Cabletron, SynOptics, and Ungermann-Bass in particular—for the past eight years.

Chassis hubs are just that—chassis that are configured through various modules. Ethernet switches and concentrators, communication servers, gateways, Token-Ring bridges, and FDDI concentrators are a few examples. Their greatest value, however, is the integrated management of these LAN technologies.

With stackables, clusters of similar-looking hubs can be grouped together and later upgraded to management. What were once thought of as low-cost, even cheap, networking components for small Ethernet workgroups are undergoing a renaissance. Stackable hubs are entering the market with nearly the same level of flexibility, management, and fault-tolerance of their chassis brethren while maintaining their low cost. Just last March, hub vendors reported for the first time that they shipped more stackable ports combined than they shipped chassis ports.

These stackable hubs can often get users into networking at much lower prices—$69 per port instead of more than $100 per port. This trend is moving the market in a surprising direction. Hub vendors may soon find that if high-speed and high–gross margin networking products such as Fast Ethernet, switching hubs, and ATM do not pick up steam, they will start to see their sales margins erode from 70 percent to below 50 percent—still lofty margins for the PC makers, but not for the internetworking market.

SynOptics and Cabletron are keeping their market share mainly because has been slow to enter the stackable market, and its latest Secure Fast Packet Switch architecture, the MMAC-Plus, leaves stackables out of the loop entirely. Ungermann-Bass, once a leader in the hub market, has been blindsided by the stackable movement that has contributed to its recent hard times.

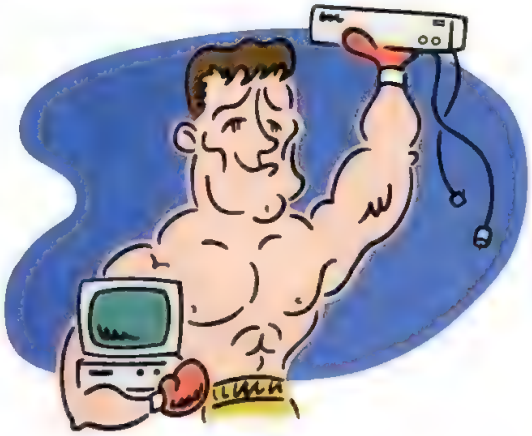
As the hub market moves to a volume business, hub vendors must have experience in price-sensitive markets with the right channels of distribution. Two companies come to mind: HP and 3Com.

Both HP and 3Com have large manufacturing facilities to produce at a lightning pace at low cost. 3Com comes by this experience through its network adapter line, while HP has long been in consumer markets with its printer and calculator businesses. Both companies announced stackables as key to their success in the hub market.

3Com says over the course of this year it will deliver a blitz of new stackable products called SuperStack. 3Com's SuperStacks will offer Ethernet, Token-Ring, FDDI, Fast Ethernet, remote routing, dial-up routing, and SNA-to-LAN connectivity. The pricing strategy will be modular, offering routing, bridging, and network management per stackable hub for additional cost.

HP has also announced a new stackable hub: AdvanceStack. AdvanceStack is a group of stackable hubs including 10BaseT Ethernet, the new 100BVG 100-Mbps Demand Protocol Ethernet, a LAN switch, plus a range of routers. It is also pre-packaging its stackables. For example, its 100BVG stackable is a 15-port hub supporting both Token-Ring and Ethernet framing, while its 10BaseT hubs come in combinations of 12-, 24-, and 48-port varieties. Clearly missing from HP's AdvanceStack are Token-Ring and FDDI stacks.

The change in market leadership will affect how companies market and plan their products. Price will become the critical buying point. Even if 3Com and HP aren't successful in their bid to usurp SynOptics, Cabletron, and Ungermann-Bass, one thing is clear: Stackables are now a crucial part of any network infrastructure.□



If Sly Stallone were

NICK LIPPIS is a contributing editor for *PC Magazine* and is president of Strategic Networks

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Things Are Seldom What They Seem

Buzzwords are useful shorthand when they have precise and well-understood meanings, but something's wrong: The buzzwords flying before my eyes mean two or three things. . .or nothing at all. Instead of shorthand, it's marko-babble.

Many of the problems involve the word *server.* What is a server? I think it's a box with multiple processors, error correction code memory, redundant power supplies, and hardware fault monitoring—like the Compaq ProLiant. Isn't it funny, though, the number of machines sold as servers that are merely PCs with extra drive bays and 100 extra watts in the power supply? Of course, under Windows for Workgroups, LANtastic, or POWERlan, a server is practically any PC that boots DOS.

How about *client/server*? Does it refer to a configuration with a central file server (like NetWare's typical configuration) or to the use of remote procedure calls to execute processes on a server? The term has been diluted to mean almost nothing.

Frank Derfler: Buzzwords may mean one or two things

Application servers has me really confused. Are we talking about remote procedure calls executing processes on a fast machine? When I look at the Citrix WINview application

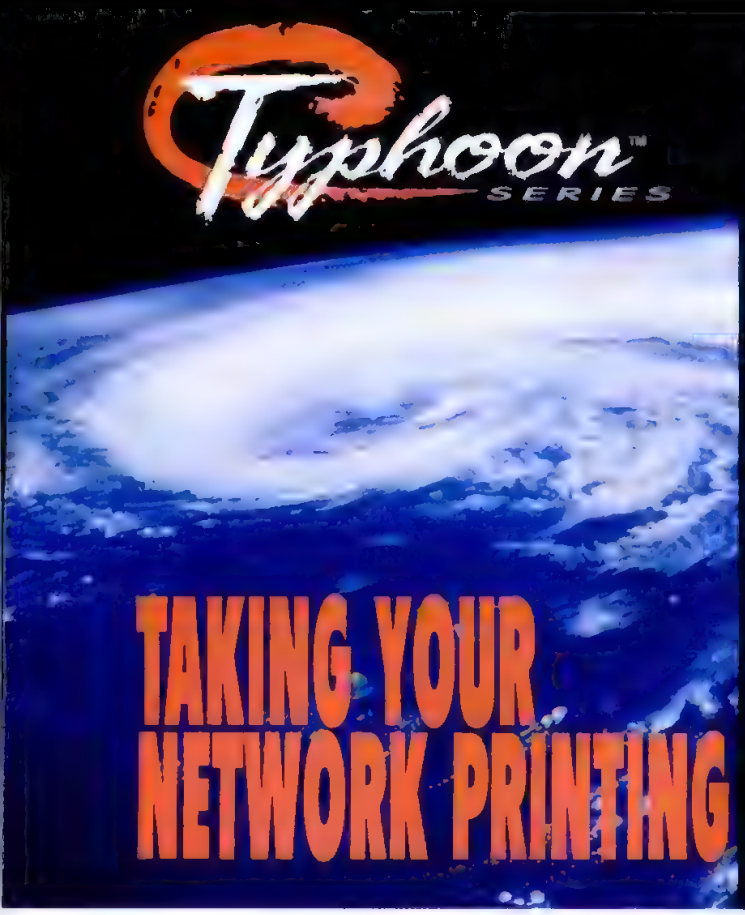
Frank, my two least favorite terms with no sure meaning are *network management* and *agents.* These are followed closely by the acronym MIS.

Today, if you ask me, practically any utility or task is part of network management. The term *network management* is as broad as the term *physiology* in biology. Network managers talk about managing the backup process or storage management. Studying network traffic patterns has long been regarded as the bastion of hard-core network management.

But now vendors such as Brightworks, Central Point Software, and Intel are offering network management packages that inventory a PC's hardware or catalog the applications a user is running. Many devices ship or will ship with a Simple Network Management Protocol (SNMP) agent, and that allows a central station to manage printers, UPSes, PCs, servers, and operating systems, not to mention the more traditional bridges and routers.

David Greenfield: The term network management *is as broad as the*

And while we are on the subject, what exactly is an agent anyway? AT&T came out with Intelligent Agents that perform specific tasks like making travel arrangements, but didn't 3Com introduce Smart Agents that performed special management



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Data that is correct and complete is vital to your business. This issue's Corporate Developer introduces you to the rules of data integrity and shows you how to enforce them to preserve your data.

Tutor

BY JEFF PROSISE

Boosting Processor Performance

In March of this year, Intel added two new members to its 80486 microprocessor family: one that runs at 100 MHz and another that runs at 75 MHz. Later this year, an 83-MHz chip will be added to the line. Called IntelDX4 microprocessors, these chips are basically 80486s that use clock-multiplying technology similar to the clock-doubling technology used in 50-MHz and 66-MHz 486DX2s. Clock multiplying increases the CPU's speed internally without increasing it externally, boosting processor performance without requiring wholesale modifications to the surrounding hardware.

DX2-based PCs have enjoyed tremendous popularity since their introduction in 1992, primarily because of the relatively low cost per MIPS (million instructions per second) of computing power that they offer. You can buy a 50-MHz 486DX2 for only a little more than a 25-MHz 486DX and for substantially less than a 50-MHz 486DX. In turn, you get about 90 percent—sometimes as much as 95 percent—of the performance of the 50-MHz 486DX. DX4s will drive the cost per MIPS even lower. A typical 100-MHz DX4 system will offer about two and a half times the processing speed of a 33-MHz 486DX-based system for only about $500 more. This estimate is based on the assumption that a 33-MHz 486 system board can be adapted to the 100-MHz DX4 for just a few dollars per unit and on the $300 cost difference (per chip) between the 33-MHz 486DX and the 100-MHz DX4 when purchased in quantities of 1,000. For comparisons of the first crop of DX4 machines, see the feature "DX4: The Value Performer" in this issue.

The 80486 line isn't the only member of the 80*x*86 family to benefit from clock-multiplying technology. Intel's newly announced 90-MHz and 100-MHz Pentiums use clock multiplying, too. These chips aren't "true" 90-MHz and 100-MHz processors; respectively, they operate at 90 MHz and 100 MHz internally and 60 MHz and 66 MHz externally. Intel has even demonstrated a Pentium that runs at 150 MHz internally and 75 MHz externally. Clearly, clock multiplying will play an important role in the continued evolution of Intel microprocessors. In order to help you understand this technology, here is a brief look at how clock multiplying works and the practical effects that it has on performance.

CLOCK-MULTIPLYING PRIMER The concept behind clock multiplying is simple. A processor chip's internal components are driven by a master clock-signal input through one of the processor pins. This *clock signal* is simply a pulse generated at regular intervals by a crystal. If the clock-signal rate is 25 MHz, then a pulse arrives every 40 nanoseconds (a nanosecond is 1 billionth of a second), for a total of 25 million pulses per second—that is, 25 MHz. The higher the clock-signal rate, the faster the CPU can carry out its internal operations and the greater its overall throughput. PC performance depends on several other factors, but CPU speed is a significant variable in the performance equation.

One way to boost a PC's performance is to increase the rate of the clock-signal input to its CPU. Doubling the clock signal from 25 MHz to 50 MHz, for example, nominally doubles the processor's performance. But increasing the clock signal has adverse side effects for system-board makers. The reason for this is that 50-MHz system boards are more expensive to design and manufacture than 25-MHz system boards, because higher clock frequencies exacerbate problems related to RF (radio frequency) emissions, propagation delays, and other concerns. This means higher prices at the retail level and greater lag times between the introduction of a new processor chip and the system boards that can accommodate it.

Increasing the clock rate within the processor while leaving the rate the same externally—a practice known as *clock multiplying*—offers a convenient solution to this problem. For example, a 50-MHz 80486DX2 chip can be used in a system board designed for a 25-MHz 80486DX with little or no modification to the system board. Because of this, you can use the right clock-multiplied chip in an existing 486 machine. Intel's OverDrive

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versions of the DX2 and other clock multiplied chips let you do exactly this. In many cases, you can just pull out the old 80486 and plug in an OverDrive chip.

In the example of the 50-MHz DX2, the clock signal into the chip is 25 MHz; to all the components on the system board, the chip appears to be a 25-MHz 80486. But internally, the DX2 chip uses a circuit called a *phase-locked loop* to double the clock speed to 50 MHz. The 50-MHz signal drives all of the chip's internal operations, including operations involving the integer unit (where the general registers are located), the floating-point unit (where all math operations are performed), the memory-management units (where logical memory addresses are converted into physical memory addresses), and other internal operating units. Only the bus interface unit (BIU), which handles memory and I/O port accesses, uses the 25-MHz clock signal.

The key to wringing maximum performance out of a clock-multiplied 486 is to minimize the number of memory and I/O port accesses that require off-chip operations. On a 486, many memory accesses can be performed on-chip, because of the 486's built-in, set-associative RAM cache and related architectural improvements. For example, virtually all memory requests are routed through the cache unit rather than passed directly to the BIU. As long as an operation remains on-chip, the 50-MHz clock speed applies. But as soon as the BIU gets involved, the chip's effective speed drops to 25 MHz. (Another performance is that most data transfers from the internal cache are performed 64 bits at a time, compared with 32 bits from the external cache.) One designer at Intel has likened this to "stepping off the high-speed highway." Under ideal conditions—for example, if the processor were doing nothing but executing multiply or divide instructions or transferring values between registers—a 50-MHz 80486DX2 system would equal or nearly equal the performance of a 50-MHz 486DX system. At the other extreme, if *every* instruction prompted a main-memory or I/O port access, the 50-MHz DX2 would be no better than a 25-MHz DX. The latter scenario is extremely unlikely.

The 90-percent performance ratio indicates that the 80486DX2 does an admirable job of minimizing off-chip accesses. That's no coincidence: The 80486 architecture was optimized to keep as many operations inside the chip as possible, making the 80486 chip an ideal candidate for clock multiplying. A clock-multiplied version of the 80386 wouldn't deliver nearly the performance boost of a clock-multiplied 80486, because the 80386 lacks a built-in RAM cache and must go off-chip to handle floating-point instructions.

A CPU's input clock rate doesn't have to be multiplied by a whole number. The 83-MHz 486DX4, for example, multiplies a 33-MHz input clock rate by 2.5 to achieve an internal operating speed of 83 MHz. Do not misconstrue the label *DX4* to mean that the clock input rate is multiplied by 4. The 100-MHz DX4 announced in March can work with input clock speeds of 33 MHz or 50 MHz and multipliers of 3 and 2, respectively. The 75-MHz 80486DX4 uses an input clock speed of 25 MHz. The *DX4* designation indicates other elements of the chip's design. For example, all 80486DX4s have 16K internal caches and are based on 3.3-volt designs (the DX4's input buffers are 5-volt tolerant, so a DX4 can still work on a system board with 5-volt components). The 486DXs and DX2s, by contrast, use 8K internal caches and operate at 5 volts. The larger cache size of the DX4 means more cache hits (and fewer off-chip memory accesses), while the lower voltage level means the chip consumes less power and generates less heat.

The doubling of the cache size from 8K to 16K is an important architectural improvement in the DX4 line. On 486-based PCs, it's customary to supplement the built-in 8K cache with up to 256K of external, or *level 2*, cache memory. While an external cache delivers dramatic performance improvements by factoring out the effects of a slow DRAM (dynamic RAM) subsystem and allowing most memory accesses to occur with zero *wait states* (clock cycles spent doing nothing while the CPU waits on another part of the system to finish an operation), it doesn't help keep memory accesses on-chip. A memory read satisfied by the external cache unit still constitutes an off-chip operation and involves the BIU. The DX4 does a better job of keeping memory operations on-chip than the DX2, because of the increased cache size. You'll still want to insist on an external cache when you buy a DX4, however. A 16K internal cache combined with a 128K or greater external cache offers the best of both worlds: fewer off-chip memory accesses and faster responses when such accesses do occur. For a lucid, in-depth discussion of memory caches look at Robert Hummel's article "Cache? Check, Charge!" in the January 1994 issue of *PC/Computing*.

PERFORMANCE ISSUES If you're shopping for a new 486-based PC, you probably don't care as much about the mechanics of clock multiplying as you do about results. How does the performance of the new DX4 line compare with the performance of existing DX2s and Pentiums?

There are many ways to measure processor performance. One of the most respected measures is the SPECint92 benchmark test, which was developed by the nonprofit Systems Performance Evaluation Cooperative (SPEC). SPECint92 subjects the processor to a mix of integer CPU instructions representative of the mixes typical in today's application programs. In tests conducted by Intel, a 66-MHz 80486DX2 achieved a SPECint92 score of 37.0. On the same test, a 100-MHz 80486DX4 scored 51.4, and a 100-MHz Pentium scored 100.0. In other words, the DX4 scored 39 percent higher than the DX2, and the 100-MHz Pentium nearly doubled the performance of the 100-MHz DX4. A 60-MHz Pentium, meanwhile, scored 53.0—only slightly higher than the 100-MHz DX4. By this measure, you could expect about the same performance from a 100-MHz DX4 and a 60-MHz Pentium. That's a point to keep in mind when you compare prices for Pentium- and DX4-based PCs.

Of course, a processor does not a PC make. A PC's throughput depends on much more than processor performance. It depends heavily on the design of the system surrounding the processor. A poorly designed system (for example, one with a slow DRAM subsystem and no external cache) can drag down the performance of even the fastest processor, while a robust system design can enhance processor performance. If you run Mi-

crosoft Windows, the choice of video card and the interface between the video card and CPU (local bus or non–local bus) are also important factors. When choosing a system, the most useful measure is one that puts the entire system, not just the CPU, to the test. For benchmark test data obtained from the first crop of DX4-based PCs, see "DX4: The Value Performer."

NON-INTEL CLOCK MULTIPLYING Is Intel the only chip manufacturer to recognize the potential of clock multiplying? Not by a long shot. Clock multiplying has become commonplace in the PC microprocessor market. IBM and Motorola's PPC601, the first member of the PowerPC family, comes in three speeds: 50 MHz, 66 MHz, and 80 MHz. The chip accepts an input clock signal twice as fast as the internal processor speed (known as a *2X* input) of 100 MHz, 132 MHz, or 160 MHz, runs internally at 50 MHz, 66 MHz, and 80 MHz, and outputs an external clock signal to drive the bus. The output frequency is controlled by the system designer and can be any integer submultiple of the input clock rate—for example, 1/2, 1/3, 1/4, and so on. Therefore, a manufacturer could easily design a PPC601-based PC with an input signal of 132 MHz that runs the processor at 66 MHz internally and the system surrounding it at 66 MHz, 44 MHz, or 33 MHz. Strictly speaking, this isn't clock multiplying, because the input clock is stepped down, not up, once it gets inside the processor. But the internal speed will usually be higher than the external speed, so the result is the same. The PPC601 also features a 32K internal, set-associative cache, twice the size of either the DX4 or the Pentium.

The PPC603, which will be available later this year, uses a clock-multiplying scheme similar to Intel's. The input clock drives both the processor and the bus, and a phase-locked loop multiplies the processor's internal clock rate by 1, 2, 3, or 4.

Digital Equipment Corp.'s highly acclaimed Alpha chip, the brawn behind Digital Alpha PCs, also has the capability to run faster internally than externally. The 21064-150 processor, which runs at 150 MHz; the 21064A-225, which runs at 225 MHz; and the 21064A-275, which runs at 275 MHz, use a clock-multiplying scheme similar to that of the PPC601. A 2X input clock drives the processor, and internally the input clock is divided by an integer value in order to generate an output clock to drive the bus. The 21064-150 uses dual 8K internal caches (one for code and one for data), while the 21064A-225 and the 21064A-275 feature dual 16K internal caches.

THE FUTURE IS HERE It's obvious that chip designers have jumped on the clock-multiplying bandwagon. In the future, you probably won't even know when you buy a clock-multiplied CPU. Intel's new 90-MHz and 100-MHz Pentiums include nothing in their names to tip you off that they're clock multipliers, unlike the DX2s and DX4s. You can bet that's by design, not by accident. In the not-too-distant future, all PC microprocessors will probably be clock multipliers, and you'll pay no more attention to the ratio of internal to external clock speeds than you currently pay to the color of the case.□

CIRCLE 364 ON READER SERVICE CARD

Corporate Developer

BY SAL RICCIARDI

Introduction to Data Integrity

Suppose you're the owner of a manufacturing business and want to compute the profit per unit manufactured for your widgets. You take your sales price from the sales report and your cost to produce from the costs report, and then calculate the difference. The result looks good. Months later, you discover that the costs report understated expenses, because data entry personnel entered certain costs without assigning them to a product. As a result, your recent business decisions were based on bad information; some products are a lot less profitable than you thought they were. The new results are not good, and you count yourself lucky to be in business still.

Data that is correct and complete is vital to your business. If your database contains incorrect information, such as costs that haven't been assigned to a product, reports based on that data will include incorrect results. To prevent this, you must ensure that the information in the database remains correct and complete at all times (in other words, that the data has integrity). In this column, I'll discuss some of the concepts surrounding data integrity.

DATA INTEGRITY Webster's defines the term *integrity* as "an unimpaired condition" and "the quality or state of being complete or undivided." This definition works well when applied to the field of database management. A database has integrity when it is both correct and complete. Making sure that your database remains this way means preventing both the entry of incorrect or incomplete information and the removal of required information.

In the real world, we apply certain rules to information. These rules help define the information's correctness. For example, you probably record all telephone numbers for customers whose country is the United States in the same manner: (999) 999-9999. Here, the rule is that the information should be 14 characters in length with the area code coming first and enclosed in parentheses, followed by a space and the next 3 digits, and followed finally by a dash and the final 4 digits. If someone enters a telephone number formatted differently, you'll likely correct them and point out the advantages of consistency. By enforcing this consistency, you reap several benefits, including improved appearance on reports and the ability to scan through columns of like-formatted information easily.

In this case, the format and structure of the information affect its correctness, and many of today's database-management products provide ways for you to control the structure and format of entered information.

Your business context probably calls for additional rules. For instance, you might have a rule that a customer can place a credit order only if his record has a Y in the credit-allowed field or a rule that says all costs must be assigned to a product. These are examples of business rules that must be enforced by the database. In this sense, the database must mirror reality and not allow anything that isn't allowed in the real world. This is in keeping with the spirit and purpose of a database, which is to model a real-world situation accurately.

When applied to databases, all of these rules are called *integrity rules*, or *integrity constraints*. They define what constitutes data integrity for a particular database. In most cases, the number of integrity rules for a given database is likely to be large. The challenge, then, is to find a way to enforce all of these rules and preserve data integrity.

MAINTAINING DATA INTEGRITY The database-management products that are available today vary widely in their ability to support the enforcement of data integrity rules. Many products provide support for enforcing only certain types of integrity rules (for example, support for formatting and structuring information when entered but not for specifying more general business rules). Others provide only those capabilities that you are able to marshal together using the database programming language that accompanies the product (some Xbase products, for example). The extent to which you can enforce data integrity depends largely on your choice of database-management product.

The database-management products that are available today vary widely in their ability to support the enforcement of data integrity rules.

Vendors of database-management systems (DBMSs) usually endow their products with one of two general methods by which you can enforce data integrity. With declarative integrity, you declare the integrity rules to the database once, and the database-management system automatically enforces them. With procedural integrity, you're responsible for writing procedures to enforce the integrity rules.

PROCEDURAL INTEGRITY Traditional database-management systems that do not adequately support the relational database model force you to write programs or procedures that enforce data integrity. A database-management sys-

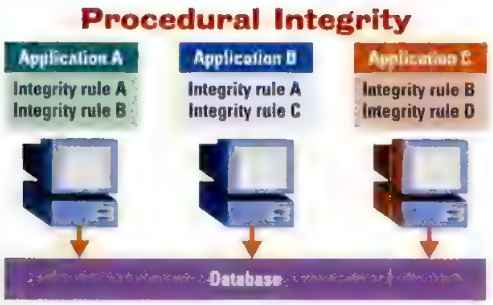


Figure 1: **With procedural integrity, you enforce integrity rules at the application level. There's no guarantee that all the rules will be correctly enforced in each application, and users or applications that access the database directly can easily bypass integrity rules.**

tem that works this way is said to support procedural integrity, because you must write procedures to enforce the integrity rules.

Procedural integrity can be problematic. In practice, many application programs and end users access and update a database. For example, a number of different order-entry applications might update a customer database. To enforce integrity, each application must know the rules and how to enforce them. In other words, each application must include the custom programs and procedures necessary to ensure integrity. Because the integrity rules exist at the application level, it's easy for another application or user to access the database directly and bypass the integrity rules. This is graphically depicted in Figure 1.

DECLARATIVE INTEGRITY In contrast, some modern database-management systems (those that support the relational model to a greater extent) support declarative integrity. With declarative integrity, you declare the integrity rules to the database-management system, and it automatically stores the rules and enforces them. Because the rules are part of the database, applications and users cannot bypass them. This is shown in Figure 2.

DECLARATIVE VERSUS PROCEDURAL While the obvious advantage to declarative integrity is that applications and users can't bypass the rules, it's not the only advantage. Another advantage is that you have to get the rules right only once. With procedural integrity, the potential for error increases with each additional application, because you have to repeat the code required to enforce the integrity constraints.

Another advantage of declarative integrity is that it lets the DBMS determine the best way to do the work. Simply declare the integrity rule and let the DBMS figure out how to enforce it. Procedural integrity, on the other hand, forces you to learn the steps required to enforce the rule programmatically, often using a language unique to that product. Your job is easier if the system can do the work for you.

Finally, the rules that define data integrity sometimes change with business conditions. In a declarative system, you can easily update the stored rules. With procedural integrity, on the other hand, you must implement the changes wherever the rules are. In other words, you must update every application.

AN EXAMPLE Recall that a primary key is the column you chose to identify each row in a table uniquely. One of the most fundamental integrity rules, one that exists in every relational database, states that the primary-key column must always contain a value (this is called the *entity integrity rule*). After all, if a row's primary-key value is missing, the DBMS loses its primary means of identifying the row.

Let's consider how you enforce this rule. If you're using a DBMS that supports ANSI SQL-92, simply declare the primary-key column when you create the table, like this:

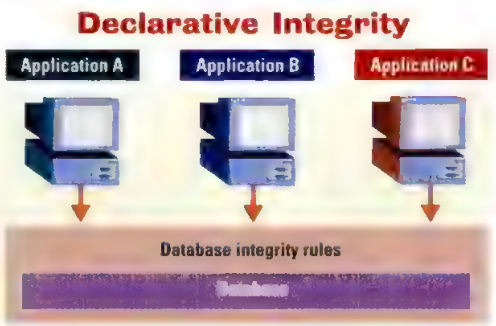


Figure 2: **With declarative integrity, you declare integrity rules only once, directly to the database, where they are stored. The database system enforces the rules automatically, blocking any attempts by applications or users to change the rules.**

```
CREATE TABLE Cust (
CustID Char(6),
        (more columns)
PRIMARY KEY (CustID) )
```

In this example, CustID is the primary key for the Cust table. Once you define the database table to have the CustID be the primary key, the database management system rejects any attempts to enter a row with a missing CustID. It also rejects any attempt to enter a CustID that already exists, because a primary-key column cannot allow duplicates. This is an example of declarative integrity, because all you have to do is declare the column as the primary key, and the DBMS enforces the primary key integrity rules automatically and globally. (For a more detailed look at primary keys, see "Introduction to Logical Database Design," *PC Magazine*, January 11, 1994.)

With Microsoft Access, it's just as simple. To enforce the rule, you simply use the Set Primary Key menu option to declare your primary-key column, as shown in Figure 3. After that, Access rejects any attempt to enter a row with a missing primary-key value. Keep in mind that the database monitors *all* update attempts, whether they come through forms, through a *datasheet* (a tabular view of a table), through importing external information from another product, or through a programmatic request using Access Basic—Microsoft Access's programming language.

Most Xbase packages, such as Borland's dBASE or Microsoft FoxPro, on the other hand, support only procedural integrity and do not have any built-in support for primary keys. This means that you must write custom code in order to prevent the insertion of a row with a missing primary-key value, and you must employ that code wherever an update can occur. Clearly the declarative approach is preferred.

HOW SECURITY AFFECTS INTEGRITY You use the data-integrity rules to protect data from users who have access to the database. You use security, on the other hand, to determine who has access to the data to begin

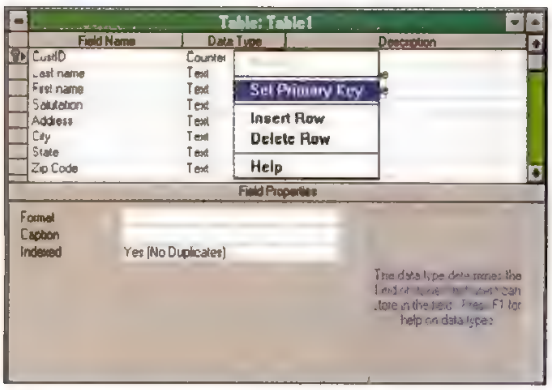


Figure 3: **Microsoft Access automatically prevents you from entering a row without a value in the primary-key column. All you have to do is choose a primary-key column using the Set Primary Key menu option.**

with. The two work hand in hand, because without security, it's easy to compromise data integrity.

Consider, for example, a hypothetical, PC-based DBMS that supports declarative integrity and runs on the world's most prevalent operating system, DOS. Someone can always compromise the integrity of a database created with this system, because the operating system has no security to speak of. All it takes is a developer with low-level access to the database files or a user skilled at using DOS commands such as ATTRIB and ERASE.

The ideal situation is where the database fully supports declarative integrity, and all access to the database passes through the database management system so that it can always enforce the integrity rules. This can happen only when the operating system has a robust security system. Keep this in mind when choosing your database management system and operating environment.

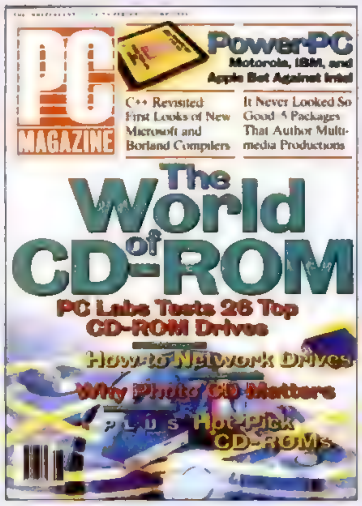
CALL YOUR VENDOR Products that support only procedural integrity are not totally without merit. Some have strengths where declarative products have traditionally been weak, such as in providing a capable and flexible programming language. Most procedural products are beginning to include more relational-database features—a welcome sign but apparently a slow process.

In the meantime, if you're using a product that does not support declarative integrity, you should encourage your vendor to incorporate the features required to do so. Those products that do not are likely to become a footnote in database history.

Beyond the different methods—declarative and procedural—used to enforce the data integrity rules are the rules themselves. I'll discuss the diffrent types of data integrity rules in the next installment of Corporate Developer.

THE MAILBOX Send comments, questions, or suggestions to Sal Ricciardi, contributing editor, via MCI (347-7663) or CompuServe (72241,33). □

SAL RICCIARDI IS A CONTRIBUTING EDITOR OF *PC MAGAZINE* AND THE AUTHOR OF *RUNNING MICROSOFT FOXPRO FOR WINDOWS* AND *RUNNING MICROSOFT FOXPRO FOR MS-DOS*, FROM MICROSOFT PRESS.



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Toolkits

BY BOB FLANDERS

Visual Voice Answers the Phone

Have you ever called your bank to find out your balance and had a computer answer the phone? The computer that answered and read your account information is called an interactive voice response (IVR) system. These systems can save a company money by reducing the number of employees it must hire but have traditionally been expensive to install.

Visual Voice Version 1.01, a Microsoft Visual Basic custom control from Stylus Innovation, changes the IVR landscape. The software for two telephone lines costs $495 and the required add-in board is $695—a combination costing far less than a conventional IVR system.

If you have a fax modem and Delrina Corp.'s WinFax PRO software, you can also send a fax from within your application. This is useful for fax-back systems in which people can dial in, select an article from a menu, and have it faxed to them.

INEXPENSIVE AND EASY TO USE With the Visual Voice custom control and only one or two lines of Visual Basic code, a program can answer the phone, place a call, play prerecorded message files, wait for Touch-tone entries, record a message, or speak a time, date, number, or dollar amount. For example, if you set the control's Value property to 215.42 and the Action property to VV_PLAY_MONEY, the Visual Voice application will say "Two hundred fifteen dollars and forty-two cents." The words are stored in a series of voice files that ship with the product. If you want a consistent voice, of course, you'll have to rerecord the files.

Along with the custom control, Visual Voice provides a workbench utility that helps you create and manage objects, such as voice files, voice queries, and subroutine templates. After you build these objects, the workbench creates the code needed to use them. You can then incorporate the code into your Visual Basic program using the Clipboard.

The workbench lets you record and play back voice files (digital recordings) using a telephone connection. It also eases the creation of voice strings—combinations of voice files and variable data that can be played as a single unit. Using a voice string, your program could play a voice file that says "Your account balance is" and then give the value "five-hundred seventy five dollars and twenty-two cents" with a single play request.

A voice query plays a prompt to the caller and then either waits for a Touch-tone response or records a voice reply. Using a voice query, Visual Voice can say "Please enter your account number followed by the pound sign" and then wait for the information. Touch-tone responses can be of fixed or variable length.

The most complex object supported by the workbench is the subroutine template—a series of actions (such as pick up the phone, dial a number, play a file, and run a voice query) that can be reused across applications.

SOME INSTALLATION HEADACHES To use Visual Voice, you must install a Dialogic voice board and the associated drivers. These range in price from $695 for a 2-line board to $3,450 for a 12-line board.

The Visual Voice software installed without problems, but we had to try several combinations of hardware interrupts, memory addresses, and device driver load orders before we were able to get the Dialogic board installed and working correctly. We encountered conflicts on interrupts that were apparently free. Once it was working, however, we had no further difficulties.

The Visual Voice documentation is thorough and easy to read. The manual also goes into detail about such topics as detecting call completion and line drops, maximizing system performance, and preparing your application for distribution.

If you need to build an IVR system, take a look at Visual Voice. Its low cost and ease of use make it an excellent choice.

▶ **Visual Voice, Version 1.01.** List price: *2 lines, $495; 4 lines, $995; 10 lines, $1,895; Dialogic board, $695 (2 lines) to $3,450 (12 lines).* Requires: *386 or higher, 5MB RAM, 3.5-inch disk drive, 8MB hard disk space, Microsoft Windows 3.x, Microsoft Visual Basic 2.x, Dialogic voice board, two phone lines or one phone simulator.* Stylus Innovation Inc., *One Kendall Square, Bldg. 1500, Cambridge, MA 02139; 617-621-9545; fax, 617-621-7862.*

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OFF THE STACK

• **Manugistics** has released a Windows version of APL—a programming language for applications that require matrix algebra, such as statistics. The new 32-bit APL*PLUS III for Windows ($995) adds an interactive environment for performing data analysis and will run on Windows 3.1, Windows for Workgroups, Windows NT, and the upcoming Windows 4.0. Manugistics Inc.; *800-592-0050, 301-984-5123.*

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• **Sense8 Corp.**'s toolkit for building real-time virtual reality and graphics simulation applications, WorldToolKit for Windows ($795), has just started shipping. WorldToolKit can read 3-D objects created by any tool that generates .DXF or .3DS files, such as AutoCAD, 3D Studio, or Swivel 3D. Hardware requirements are heavy— 486DX/50 or better is required, and a Pentium-based system with local-bus video is recommended.
Sense8 Corp.; *415-331-6318.*

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Environments

BY CHARLES PETZOLD

Selecting and Displaying Fonts in Windows NT

Microsoft Windows 1.0 was released in the fall of 1985, which means that much of the internal design must have been in place in 1984—ten years ago! While later revisions have brought many needed enhancements to Windows, programmers still use many of the same function calls from the original version. In most cases, that's not a problem. But for font selection, it is.

Microsoft Windows 1.0 engineers designed font-selection logic to display raster (also called *bitmap*) fonts on the screen and also to accommodate situations where fonts built into a printer did not have exact screen equivalents. Those early designers of Windows tried to solve some problems associated with these raster fonts. While these problems have largely been eliminated with the advent of outline-font technologies, such as TrueType, the old font-selection logic remains.

DOING IT THE OLD WAY To understand the rationale behind the font-selection logic in Windows, let's turn the clock back to 1984. A laser printer was still a luxury item and the new Hewlett-Packard LaserJet was available for a street price of $3000, as mentioned in the *PC Magazine* annual roundup of printers in the issue of November 27, 1984.

At the time, all printers—laser, ink jet, daisy wheel, and dot matrix—and plotters had their own built-in fonts. With the introduction of PostScript laser printers, such as the Apple LaserWriter, it was finally possible for software to scale printer fonts to any desired size.

Screen-font technologies proceeded at a much slower pace than printer-font technologies. But because Windows 1.0 was a graphical environment, it had to give the user some way to view printer-destined text accurately on the screen. Outline fonts would have helped, of course, but remember that Windows 1.0 could be run on two floppy disk drives on a 4.77-MHz, 8088-based computer, and the performance would have been intolerable. Besides, outline-font technology was still new and expensive.

With TrueType, we have the improved typeface-outline technology, but font selection is still based on functions created ten years ago.

So Windows 1.0 used mostly raster fonts and also had three scalable vector fonts (basically unfilled polylines) that nobody really liked. The font-selection logic in Windows was designed so that those raster fonts would emulate what the user should eventually see on the printed page. Here's how a Windows 1.0 word processing program would handle the job of selecting fonts:

First, the program obtained a list of fonts available on the default printer by calling the EnumFonts function. This function returned information about each font, using the LOGFONT and TEXTMETRIC structures. The program then presented these names and sizes to the user for selection.

After the user selected a font, the program could then pass the LOGFONT structure to the CreateFontIndirect function. That font could then be selected into the printer device context for printing or into the video device context for displaying on the screen. Easy, right?

Not so fast. If the LOGFONT structure describes a printer font, how can a font based on that same structure be selected into the video device context? A screen equivalent of that font might not be available. This is where the magic takes place. Windows has a font-mapping algorithm that attempts to find on the device a font that most closely matches the font characteristics described in the LOGFONT structure.

Word processing programs determine spacing and line breaks of the text based on information available from the printer device context (after the font has been selected into the printer device context, of course), and they use this information to display text on the screen.

Considering that these screen fonts were often gross approximations of the

```
/*----------------------
   EZFONT.H header file
  ----------------------*/

HFONT EzCreateFont (HDC hdc, char * szFaceName, int iDeciPtHeight,
                    int iDeciPtWidth, int iAttributes, BOOL fLogRes) ;

#define EZ_ATTR_BOLD          1
#define EZ_ATTR_ITALIC        2
#define EZ_ATTR_UNDERLINE     4
#define EZ_ATTR_STRIKEOUT     8
```

Figure 1: **The EZFONT.H header file defines the EzCreateFont function and some identifiers.**

```
/*----------------------------------------
   EZFONT.C -- Easy Font Creation
               (c) Charles Petzold, 1994
  ----------------------------------------*/

#include <windows.h>
#include <string.h>
#include <math.h>
#include "ezfont.h"

HFONT EzCreateFont (HDC hdc, char * szFaceName, int iDeciPtHeight,
                    int iDeciPtWidth, int iAttributes, BOOL fLogRes)
     {
     FLOAT      cxDpi, cyDpi ;
     HFONT      hFont ;
     LOGFONT    lf ;
     POINT      pt ;
     TEXTMETRIC tm ;

     SaveDC (hdc) ;

     SetGraphicsMode (hdc, GM_ADVANCED) ;
     ModifyWorldTransform (hdc, NULL, MWT_IDENTITY) ;
     SetViewportOrgEx (hdc, 0, 0, NULL) ;
     SetWindowOrgEx   (hdc, 0, 0, NULL) ;

     if (fLogRes)
          {
          cxDpi = (FLOAT) GetDeviceCaps (hdc, LOGPIXELSX) ;
          cyDpi = (FLOAT) GetDeviceCaps (hdc, LOGPIXELSY) ;
          }
     else
          {
          cxDpi = (FLOAT) (25.4 * GetDeviceCaps (hdc, HORZRES) /
                                  GetDeviceCaps (hdc, HORZSIZE)) ;

          cyDpi = (FLOAT) (25.4 * GetDeviceCaps (hdc, VERTRES) /
                                  GetDeviceCaps (hdc, VERTSIZE)) ;
          }

     pt.x = (int) (iDeciPtWidth  * cxDpi / 72) ;
     pt.y = (int) (iDeciPtHeight * cyDpi / 72) ;

     DPtoLP (hdc, &pt, 1) ;

     lf.lfHeight         = - (int) (fabs (pt.y) / 10.0 + 0.5) ;
     lf.lfWidth          = 0 ;
     lf.lfEscapement     = 0 ;
     lf.lfOrientation    = 0 ;
     lf.lfWeight         = iAttributes & EZ_ATTR_BOLD      ? 700 : 0 ;
     lf.lfItalic         = iAttributes & EZ_ATTR_ITALIC    ?   1 : 0 ;
     lf.lfUnderline      = iAttributes & EZ_ATTR_UNDERLINE ?   1 : 0 ;
     lf.lfStrikeOut      = iAttributes & EZ_ATTR_STRIKEOUT ?   1 : 0 ;
     lf.lfCharSet        = 0 ;
     lf.lfOutPrecision   = 0 ;
     lf.lfClipPrecision  = 0 ;
     lf.lfQuality        = 0 ;
     lf.lfPitchAndFamily = 0 ;

     strcpy (lf.lfFaceName, szFaceName) ;

     hFont = CreateFontIndirect (&lf) ;

     if (iDeciPtWidth != 0)
          {
          hFont = SelectObject (hdc, hFont) ;

          GetTextMetrics (hdc, &tm) ;

          DeleteObject (SelectObject (hdc, hFont)) ;

          lf.lfWidth = (int) (tm.tmAveCharWidth *
                              fabs (pt.x) / fabs (pt.y) + 0.5) ;

          hFont = CreateFontIndirect (&lf) ;
          }

     RestoreDC (hdc, -1) ;

     return hFont ;
     }
```

Figure 2: **The EZFONT.C file contains the EzCreateFont function.**

printer fonts, the system worked well enough. For example, if the size of the requested font did not match the sizes of the available screen fonts, Windows would pick a font with the next smallest available size so that lines of text wouldn't run together and overlap on the screen.

WORKING BACKWARDS But with typeface-outline technologies, such as TrueType, this process of selecting fonts seems backwards. If you were to attempt to rethink font selection from scratch, here's what you might conclude:

Printers shouldn't have their own built-in fonts. Outline fonts should be stored on the PC's hard disk or on CD-ROM. These fonts could then be both used on the screen and sent out to the printer. The problem with built-in printer fonts is that they cannot be pulled into the PC for displaying on the screen.

In fact, it would even help for printers to become dumb pieces of hardware that simply accept an entire page image in the form of a bitmap and slap that image on paper. The graphical environment on the PC would be responsible for creating this bitmap. The big advantage to this approach is that we'd have a single imaging model with one graphics system responsible for rendering text and other images, improving consistency between the video image and the printer page.

That would be ideal, but the world (and Windows) is not ideal. With TrueType, we have the improved typeface-outline technology, but font selection is still based on functions and data structures created ten years ago.

THE COMPROMISE As I discussed in the last column, it would be most convenient to select video and printer fonts in a manner consistent with traditional typography. That is, selecting a font should be as simple as specifying a typeface name and a point size.

The EZFONT (easy font) files shown in Figures 1 and 2 can help achieve this goal with a function called EzCreateFont. I described the principles behind this function in the last Environments column.

First, the EzCreateFont function begins by saving the state of the device context. Because the function changes various attributes of the device context, you must restore the device context at the conclusion of the function.

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```
/*----------------------------------------
   EZTEST1.C -- EZFONT Test Program # 1
                (c) Charles Petzold, 1994
  ----------------------------------------*/

#include <windows.h>
#include <string.h>
#include "ezfont.h"

char szClass [] = "EzTest1" ;
char szTitle [] = "EzTest1:  EZFONT Test Program # 1" ;

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
     {
     CHAR       szBuffer [64] ;
     HFONT      hFont ;
     INT        y, iDeciPtHeight ;
     TEXTMETRIC tm ;

     SetBkMode (hdc, TRANSPARENT) ;

     y = 0 ;

     for (iDeciPtHeight = 120 ; iDeciPtHeight <= 140 ; iDeciPtHeight ++)
          {
          hFont = EzCreateFont (hdc, "Times New Roman Bold",
                                iDeciPtHeight, 0, 0, TRUE) ;

          SelectObject (hdc, hFont) ;

          GetTextMetrics (hdc, &tm) ;

          wsprintf (szBuffer, "This %d.%d point font is %d pixels high",
                    iDeciPtHeight / 10, iDeciPtHeight % 10,
                    tm.tmHeight - tm.tmInternalLeading) ;

          TextOut (hdc, 0, y, szBuffer, strlen (szBuffer)) ;

          SelectObject (hdc, GetStockObject (SYSTEM_FONT)) ;
          DeleteObject (hFont) ;

          y += tm.tmHeight - tm.tmInternalLeading ;
          }
     }
```

Figure 3: **The EZTEST1.C program displays fonts with point sizes from 12.0 to 14.0.**

The function continues by setting the world transform to the identity matrix. As I discussed in the last column, EzCreateFont must perform a conversion of device coordinates to logical coordinates, and any world transform should not affect this conversion (you'll see the reason for this later). The function also sets the viewport and window origins to 0 so that the coordinate conversion works correctly.

Next, the function calculates a device resolution in dots per inch. If the last parameter to the function is TRUE, the function uses the logical resolution; otherwise, it calculates a resolution based on the size of a normal screen. At this point, the function can calculate a character height and width in pixels. The CreateFontIndirect function requires a character height to be in logical units, so the EzCreateFont function passes these sizes to the DPtoLP (device point to logical point) function.

The function can then set up a LOGFONT structure. Notice that the lfHeight field is set to the negative of the character height. This means that GDI should interpret the height as a point height. (I'll have more to say on this subject later.) For the time being, the lfWidth field is set to 0. This directs the CreateFontIndirect function to create a font with a normal width for the point size.

THE CHARACTER WIDTH If the lfWidth field of the LOGFONT structure is set to a nonzero value, it indicates a desired average width of characters in the font. For a particular font height, every font has an average character width, based on a weighted average of lowercase characters in the font. The weighted average is based on the frequency of the letters as they occur in the English language.

The concept of the average character width is another remnant of the time when we used raster fonts exclusively. Programs would use the lfWidth field if they had to fit a line of text within certain boundaries. Specifying an average character width, however, makes no sense when selecting fonts based on traditional typographical concepts.

For example, suppose you want a normal 12-point font. If your program was running on a VGA system, and you want-

```
/*----------------------------------------
   EZTEST2.C -- EZFONT Test Program # 2
                (c) Charles Petzold, 1994
  ----------------------------------------*/

#include <windows.h>
#include <string.h>
#include "ezfont.h"

char szClass [] = "EzTest2" ;
char szTitle [] = "EzTest2:  EZFONT Test Program # 2" ;

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
     {
     CHAR       szBuffer [64] ;
     HFONT      hFont ;
     INT        y, iDeciPtHeight ;
     TEXTMETRIC tm ;

     SetBkMode (hdc, TRANSPARENT) ;
     SetMapMode (hdc, MM_TWIPS) ;
     SetViewportOrgEx (hdc, 0, cyArea, NULL) ;
     SetTextAlign (hdc, TA_LEFT | TA_BOTTOM) ;

     y = 0 ;

     for (iDeciPtHeight = 120 ; iDeciPtHeight <= 140 ; iDeciPtHeight ++)
          {
          hFont = EzCreateFont (hdc, "Times New Roman Bold",
                                iDeciPtHeight, 0, 0, TRUE) ;

          SelectObject (hdc, hFont) ;

          GetTextMetrics (hdc, &tm) ;

          wsprintf (szBuffer, "This %d.%d point font is %d twips high",
                    iDeciPtHeight / 10, iDeciPtHeight % 10,
                    tm.tmHeight - tm.tmInternalLeading) ;

          TextOut (hdc, 0, y, szBuffer, strlen (szBuffer)) ;

          SelectObject (hdc, GetStockObject (SYSTEM_FONT)) ;
          DeleteObject (hFont) ;

          y += tm.tmHeight - tm.tmInternalLeading ;
          }
     }
```

Figure 4: **The EZTEST2.C program uses the MM_TWIPS mapping mode to display fonts with point sizes from 12.0 to 14.0.**

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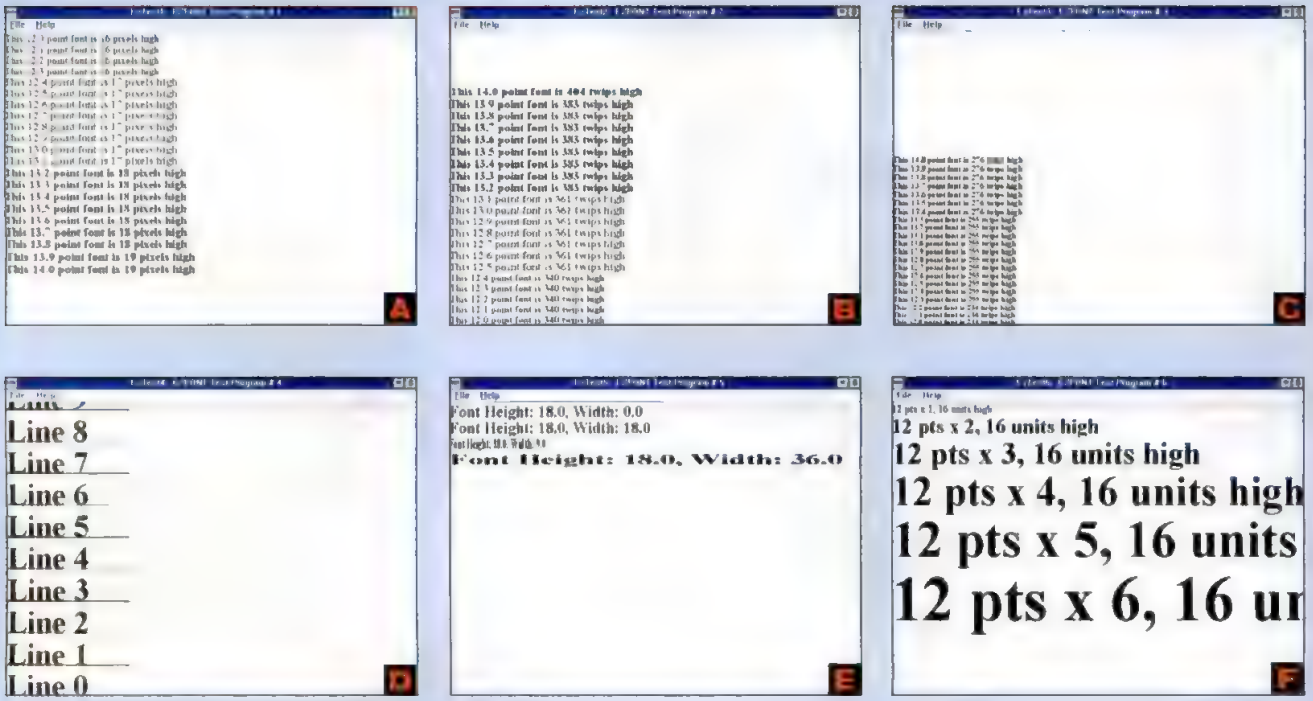
Font Displays



Screens *A*, *B*, and *C* show fonts with point sizes ranging from 12.0 to 14.0, as displayed by the EZTEST1, EZTEST2, and EZTEST3 programs, respectively. The EZTEST4 display (screen *D*) shows consistency between text sizing and graphics coordinates. The EZTEST5 display (screen *E*) shows a font with different character widths. The EZTEST6 display (screen *F*) shows a font that was increased in size by using the world transform. All of these screens were produced on a standard VGA display.

ed to base your fonts on the logical resolution of the screen (96 dots per inch for VGA) and were working in units of pixels, you would set the lfHeight field to -16 and the lfWidth field to 0.

Now suppose you want a 12-point font with twice the normal width. How do you set the lfWidth field? It would have to be twice the average character width of the normal 12-point font. But what is that value? It depends on the particular font, and you can't really tell until you've examined the normal-width font using the TEXTMETRIC structure.

It makes more sense to specify the font size in terms of the em square. This is a very old concept in typography. It goes back to the days when only capital letters were used in printing. The size of the capital M was as wide as it was tall. That's the em square.

In more recent times, an em height is the point size of the font, and the em width refers to the width of the characters expressed in points. For example, a normal 12-point font has an em width of 12 points. But this has nothing to do with the average width or the maximum width of the characters or the width of the capital M. It's much more abstract than that. Very simply, if the point size of the font is 12, and the em width is 24, then the characters are twice as wide as normal.

The fourth parameter to EzCreateFont lets you specify an em width in decipoints. A 0 value for this parameter gives you the normal width. The function must first create a font with a normal width, obtain the average character width, and create a new font by setting the lfWidth field of the LOGFONT structure to the normal average width scaled to the ratio of the em width to the em height.

TESTING IT OUT The EzCreateFont function allows the character height to be specified in decipoints, or units equal to $^1/_{720}$ inch. Let's see if we can create fonts with point sizes ranging from 12.0 to 14.0. This is the purpose of the EZTEST1 program shown in Figure 3.

Besides requiring the EZFONT files, the program also requires the NTGDI files shown in the January 11, 1994, installment of this column. Or you can download all the source code and executables from PC MagNet in the file EZFONT.ZIP. The results of this program running on standard VGA are shown in screen A in the sidebar "Font Displays."

Notice that the program displays the height of the font using information from the GetTextMetrics function. The height is calculated by subtracting the tmInternalLeading field of the TEXTMETRIC structure from the tmHeight field. Inter-

```
/*----------------------------------------
   EZTEST4.C -- EZFONT Test Program # 4
                (c) Charles Petzold, 1994
  ----------------------------------------*/

#include <windows.h>
#include <string.h>
#include "ezfont.h"

char szClass [] = "EzTest4" ;
char szTitle [] = "EzTest4:  EZFONT Test Program # 4" ;

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
     {
     CHAR       szBuffer [64] ;
     HFONT      hFont ;
     INT        i ;
     TEXTMETRIC tm ;

     SetBkMode (hdc, TRANSPARENT) ;
     SetMapMode (hdc, MM_ANISOTROPIC) ;
     SetWindowExtEx (hdc, 720, 720, NULL) ;
     SetViewportExtEx (hdc, GetDeviceCaps (hdc, LOGPIXELSX),
                            -GetDeviceCaps (hdc, LOGPIXELSY), NULL) ;

     SetViewportOrgEx (hdc, 0, cyArea, NULL) ;

     SetTextAlign (hdc, TA_LEFT | TA_BASELINE) ;

     hFont = EzCreateFont (hdc, "Times New Roman Bold", 360, 0, 0, TRUE) ;

     SelectObject (hdc, hFont) ;
     GetTextMetrics (hdc, &tm) ;

     for (i = 0 ; i < 10 ; i++)
          {
          wsprintf (szBuffer, "Line %d", i) ;

          TextOut (hdc, 0, i * (tm.tmHeight - tm.tmInternalLeading),
                   szBuffer, strlen (szBuffer)) ;
          }

     SelectObject (hdc, GetStockObject (SYSTEM_FONT)) ;
     DeleteObject (hFont) ;

     for (i = 0 ; i < 10 ; i++)
          {
          MoveToEx (hdc,    0, 360 * i, NULL) ;
          LineTo    (hdc, 1440, 360 * i) ;
          }
     }
```

Figure 5: **The EZTEST4.C program sets a window/viewport transform so that graphics can be drawn in units of decipoints.**

nal leading is a fudge factor that began with raster fonts. It's the difference between the height of the bitmaps used for storing the characters of the raster font and the point height. (The point height is smaller because it doesn't include accent marks and such.) When you request a font using the CreateFontIndirect function, use positive values of lfHeight to indicate a height that includes internal leading and negative values for no internal leading.

Normally you should use the tmHeight value or a larger value for spacing successive lines of text so that accents are clearly visible. In this sample program, however, I space lines of text based on the point size.

On VGA, the 12-point font is 16 pixels high using the logical resolution. This is exactly what you would expect, because of the 96-dot-per-inch logical resolution of VGA. Both 12 points and 16 pixels are $^1/_6$ inch.

We don't seem to get much advantage out of using decipoints, however. All the point sizes from 12.0 through 12.3 points are the same size (16 pixels), and all the point sizes from 12.4 through 13.1 are 17 pixels high. Obviously this is because there is no such thing as a fractional pixel. In this program, device units are pixels, and that's how the lfHeight field of the LOGFONT must be specified in the EzCreateFont function.

USING TWIPS We would get better results if we set the mapping mode to something with a much finer resolution than a pixel. The EZTEST2 program, shown in Figure 4, uses the MM_TWIPS mapping mode. *Twip* is a fabricated word standing for "twentieth of a point." When using this mapping mode, all coordinates and sizes are specified in $^1/_{1440}$ inch.

For convenience, the lines of text in EZTEST2 go from the bottom up rather than the top down. Despite this difference, EZTEST2's display (shown in screen B in the sidebar) looks much the same as EZTEST1's display.

We're still not getting the increased resolution we hoped for. Obviously, before creating the font, GDI is internally converting the logical units in the LOGFONT structure to device units (pixels). The result of this is that with VGA, you're not going to get screen fonts with greater precision than half a point or so. However, the sample programs I'm showing here have an option to print the text on a printer. For 300-dpi laser printers, you'll get a resolution of about a quarter point, which is the size of 1 pixel.

You may notice another problem with EZTEST2. The 14-point font is indicated as being 404 twips in height. But 14 points is 280 twips (14 times 20). The discrepancy results from using the logical resolution of the device to size the fonts, while GDI is using the normal resolution to set up the MM_TWIPS mapping mode.

Switching to the normal resolution for

```
/*----------------------------------------
   EZTEST5.C -- EZFONT Test Program # 5
                (c) Charles Petzold, 1994
  ----------------------------------------*/

#include <windows.h>
#include <string.h>
#include "ezfont.h"

char szClass [] = "EzTest5" ;
char szTitle [] = "EzTest5:  EZFONT Test Program # 5" ;

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
     {
     static INT iDeciPtHeight    = 180,
                iDeciPtWidth [4] = { 0, 180, 90, 360 } ;
     CHAR       szBuffer [64] ;
     HFONT      hFont ;
     INT        i, y ;
     TEXTMETRIC tm ;

     SetBkMode (hdc, TRANSPARENT) ;

     y = 0 ;

     for (i = 0 ; i < 4 ; i++)
          {
          hFont = EzCreateFont (hdc, "Times New Roman Bold",
                                iDeciPtHeight, iDeciPtWidth [i], 0, TRUE) ;

          SelectObject (hdc, hFont) ;
          GetTextMetrics (hdc, &tm) ;

          wsprintf (szBuffer, "Font Height: %d.%d, Width: %d.%d",
                    iDeciPtHeight     / 10, iDeciPtHeight     % 10,
                    iDeciPtWidth [i] / 10, iDeciPtWidth [i] % 10) ;

          TextOut (hdc, 0, y, szBuffer, strlen (szBuffer)) ;

          SelectObject (hdc, GetStockObject (SYSTEM_FONT)) ;
          DeleteObject (hFont) ;

          y += tm.tmHeight - tm.tmInternalLeading ;
          }
     }
```

Figure 6: **The EZTEST5.C program displays text with nondefault character widths.**

font sizing requires setting the last parameter of EzCreateFont to FALSE. This is done in the EZTEST3 program, not shown here because the change is so slight. (You can download EZTEST3 from PC MagNet.)

As shown in screen C in "Font Displays," the twips height now agrees with the point size or is as close as possible with the rounding errors that occur internally in GDI.

GRAPHICS CONSISTENCY The problem with EZTEST3 is that the text looks quite small. Font sizes are more readable when using the logical resolution of the device. Yet the built-in mapping modes use the normal resolution. This means that if you use one of the metric mapping modes for drawing graphics and create fonts based on the logical resolution, you'll have basic inconsistencies.

The solution is to create your own mapping modes. You can fake an MM_TWIPS mapping mode by using the logical resolution, but let's go one step further. Because you're creating fonts based on decipoints, you can draw graphics in units of decipoints. The EZTEST4 program, shown in Figure 5, demonstrates how to do this.

Setting a mapping mode causes GDI to set window and viewport extents. The ratio of the viewport extent to the window extent is the number of pixels per logical unit. The EZTEST4 program sets the window extent to the number of decipoints in 1 inch (720) and the viewport extent to the number of pixels in 1 inch, obtained from using the LOGPIXELSX and LOGPIXELSY parameters to the GetDeviceCaps function.

The program then draws several lines of text with a 36-point font (and a 36-point line spacing), and then several lines of spaces, 0.5 inch (360 decipoints) apart. As you can see in screen D, the text and graphics are perfectly consistent.

MORE TESTING There are a couple more tests that EzCreateFont has to pass before we can call it a success. First, let's look at nondefault font widths. The EZTEST5 program, shown in Figure 6, displays an 18-point font using widths of 0, 18, 9, and 36 points.

The EzCreateFont function accepts a width of 0 to represent a normal width.

```
/*----------------------------------------
   EZTEST6.C -- EZFONT Test Program # 6
                (c) Charles Petzold, 1994
  ----------------------------------------*/

#include <windows.h>
#include <string.h>
#include "ezfont.h"

char szClass [] = "EzTest6" ;
char szTitle [] = "EzTest6:  EZFONT Test Program # 6" ;

void PaintRoutine (HWND hwnd, HDC hdc, int cxArea, int cyArea)
     {
     CHAR       szBuffer [64] ;
     HFONT      hFont ;
     INT        i, y, iDeciPtHeight = 120 ;
     TEXTMETRIC tm ;
     XFORM      xform ;

     SetBkMode (hdc, TRANSPARENT) ;
     SetGraphicsMode (hdc, GM_ADVANCED) ;

     y = 0 ;

     for (i = 1 ; i <= 6 ; i++)
          {
          xform.eM11 = (FLOAT) i ;
          xform.eM12 = (FLOAT) 0 ;
          xform.eM21 = (FLOAT) 0 ;
          xform.eM22 = (FLOAT) i ;
          xform.eDx  = (FLOAT) 0 ;
          xform.eDy  = (FLOAT) 0 ;

          SetWorldTransform (hdc, &xform) ;

          hFont = EzCreateFont (hdc, "Times New Roman Bold",
                                iDeciPtHeight, 0, 0, TRUE) ;

          SelectObject (hdc, hFont) ;
          GetTextMetrics (hdc, &tm) ;

          wsprintf (szBuffer, "%d pts x %d, %d units high",
                    iDeciPtHeight / 10, i,
                    tm.tmHeight - tm.tmInternalLeading) ;

          TextOut (hdc, 0, y, szBuffer, strlen (szBuffer)) ;

          SelectObject (hdc, GetStockObject (SYSTEM_FONT)) ;
          DeleteObject (hFont) ;

          y += (tm.tmHeight - tm.tmInternalLeading) / 2 ;
          }
     }
```

Figure 7: **The EZTEST6.C program displays text with sizes increased using the world transform.**

So for an 18-point font, the resulting width should be the same whether the width is specified as 0 or 180 decipoints. Specifying 90 decipoints should create a font with half the normal character width, and 360 decipoints should yield characters with double the normal width. This technique works, as shown in screen E in the sidebar.

Finally, in the last column, I attempted to justify why I felt that font sizes should be affected by the world transform. That is, if you specify a 24-point font, and the world transform in effect doubles all sizes, then the actual displayed text should be the same size as a normal 48-point font. The EZTEST6 program shown in Figure 7 tests this by displaying six lines of a 12-point font with world transforms that double the font size, triple it, and so forth.

In all cases, the 12-point font is 16 units high. For the first line in which the default world transform is in effect, the 16 units refer to pixels. For the subsequent lines, the 16 units are logical coordinates, but because of the world transform, they are transformed to 32 pixels, 48 pixels, and so forth, as shown in screen F in the "Font Display" sidebar.

In the next column, we'll put EZFONT to work using graphics paths in Microsoft Windows NT to create some interesting effects. □

Power Programming

BY MATT PIETREK

Disassembling Windows Programs

In the last Power Programming column, I described two relatively easy approaches to reverse-engineering Microsoft Windows programs: dumping program files and using utilities that spy on a program's messages and API calls. In recent years, books such as *Undocumented DOS*, *Undocumented Windows*, and *Windows Internals* have furnished programmers with a third technique for reverse-engineering: disassembling program files. In this column, I'll show some basic techniques for reverse-engineering 16- and 32-bit Windows code via disassembly.

When other methods fail, disassembly is often the only way to crack open a mysterious algorithm or programming technique. And disassembling a program or a DLL isn't necessarily something you do only with other people's code. When you encounter a strange bug that's not immediately apparent from the source for your own code, knowing how to correlate high-level language code to the compiler-generated assembly code is an incredibly valuable skill. Likewise, disassembling your own code enables you to determine whether the compiler has generated optimal code for a heavily used routine. Yet another situation where you might disassemble your own code is when a program mysteriously crashes at a customer site. If the user can give you the address where the program blows up, you can disassemble your program at that address to see what the code is doing.

The most familiar PC-based disassembler is probably V-Communications' Sourcer. By itself, Sourcer works with DOS .EXE and .COM files. With add-on components that produce script files, Sourcer also takes apart 16-bit NE (New Executable) files, VxD LE (Linear Executable) files, and Win32 PE (Portable Executable) files. Other disassemblers for the PC include Eclectic Software's Win2Asm and Dis•Doc Professional, from RJSwantek. If you're only concerned with Win32 files and price, it's hard to beat the DUMPBIN program that comes with the Microsoft SDK for Win32. The DUMPBIN program is embedded in LINK.EXE: Use the syntax `LINK /DUMP /DISASM filename`, where *filename* is the name of a COFF (Common Object File Format) .OBJ or a Win32 PE format executable. For you Microsoft Visual C++ 32-Bit Edition users, from the command line, type `DUMPBIN /DISASM filename`.

When other methods fail, disassembly is often the only way to crack open a mysterious algorithm or programming technique.

If you just want to tinker around with the disassembly techniques shown here, you may be able to get away with using the disassembler in your debugger. By dumping the contents of several disassembly windows into a file, you can get a somewhat reasonable listing. This is tedious and time consuming, however. If you're at all serious about disassembly, get a real file-based disassembler. They're well worth the cost.

I CAME, I SAW, I DISASSEMBLED Although there is no one correct approach to reverse-engineering a piece of code, my approach can be summed up as "divide and conquer." Starting with the raw output from a disassembler, I don't tackle an entire function in one big piece. Instead, I break up the raw listing into small, manageable pieces. My ultimate goal is to work a disassembly listing into a piece of commented C pseudo-code. My book, *Windows Internals*, has many examples of this. Another use of disassemblers is to create an .ASM file that you can modify and then reassemble (when you don't have the source code, for example). This aspect of disassembly won't be covered in this column.

I'll first describe in general terms the steps I take when reverse-engineering. Then, I'll jump into the nitty-gritty details of identifying functions, function return values, parameters, local variables, global variables, string literals, and branch statements.

THE STRATEGY The steps in disassembling a function are

1. Run the executable through a disassembler to get a listing file. If you're interested in only one function, you might find it helpful to delete other code that comes before or after the relevant function. This makes the file more manageable in your editor.

2. Go through the function and label all the known entities with names that are more descriptive. By known entities, I mean arguments to the function, local variables, and global variables. The idea is to do all the easy work first. When doing a puzzle, most people do the borders first. This reduces the number of unknown pieces you have to sort through and gives a better context from which to fill in the remaining pieces. This same concept applies to disassembly.

3. Disassembly listings often contain long sequences of instructions with no intervening blank lines. It's helpful to insert blank lines before and after instruction sequences that logically belong together. This sounds vague, but it's not hard in practice. An example of such a sequence is the code that pushes parameters onto the stack and then calls another function. A helpful guideline is to try to create sequences of instructions that form a single statement in the program's source code.

Later on in the disassembly process, you may need to decode branch statements. In high-level languages, these are statements such as `if`, `while`, `do`, and `switch`. I've found that putting a blank line after each jump instruction makes it much easier to understand the listing. I do this quickly with an editor macro that searches for instructions that start with the letter `J` and inserts a blank line following that instruction.

4. If the function looks like it uses any string-literal values, add comments that contain the string. Put the comments near the function calls that use the string. Later on, this will help reduce several lines of assembly code down to one C statement.

5. Consolidate groups of assembly instructions into single pseudo-code statements. Find the instruction sequences that constitute calls to other functions for which you know the names and parameters. Study what's being pushed onto the stack and construct what the arguments to the function should look like.

6. Convert conditional branch statements into their high-level–language equivalents.

7. Repeat the preceding steps as necessary.

This last step sounds trite, but it's not supposed to be. For all but the most trivial functions, reverse engineering is an iterative process. You make a pass through the code, doing as much as you can with the information you currently have. You then step back, look at how the picture has changed, and make another pass. By figuring out one piece of the puzzle, a dozen more may quickly fall into place.

Having discussed in broad strokes how to disassemble a function, let's look at some common code sequences and code-generation conventions. This will help you translate raw assembly code into its high-level–language equivalent.

IDENTIFYING FUNCTIONS The first thing to do with the raw output from a disassembler is to figure out where the functions start and end. To find the start of a function, look for some sort of standard prologue code generated by a compiler. Of course, there is always the possibility that the code was written in assembly language, so there may not be any sort of prologue code.

The standard compiler-generated prologue code is some variation of this:

- save original (E)BP register on the stack
- assign the stack pointer to the (E)BP register
- decrement the stack pointer to make room for local variables
- save the calling function's register variables on the stack

Expressed in 16-bit assembly language, the above looks like this:

```
PUSH BP     ; Save caller's BP frame
MOV BP,SP   ; Set up new BP
            ; frame
SUB SP,XX   ; XX is the number of
            ; bytes need for local
            ; variables
PUSH SI     ; DI and SI are
PUSH DI     ; commonly used as
            ; register variables
```

When 80286 or better code generation is enabled, look for

```
ENTER XX,0    ; XX is the number of
PUSH SI       ; bytes needed for
PUSH DI       ; local variables
```

The above sequences are the full-blown prologues. In real-world code, parts or all of the prologue may be missing or different. If the function doesn't alter a register-variable register—(E)SI and (E)DI, for example—the prologue won't bother to save it. In 32-bit code, EBX is sometimes used as a register variable; in 16-bit code, BX usually isn't.

In 16-bit code, if the function doesn't take any parameters or use any local variables, the compiler may omit

```
PUSH  BP
MOV   BP,SP
```

In 32-bit code, even if the function takes parameters and uses local variables, the compiler may still not set up an EBP frame. The 32-bit addressing modes of 386 and above CPUs allow the compiler to address parameters and local variables with the ESP register:

```
MOV EAX,[ESP+1C]
```

Recognizing the function epilogue is a little trickier. If the compiler's optimizer is turned on, there may be multiple places where the function does a RET or RETF to the calling function. Assuming the function has a single epilogue at the end of the function, the full-blown 16-bit epilogue looks something like this:

```
POP DI     ; Restore caller's
           ; register variables
POP SI
ADD SP,XX  ; or LEAVE for
POP BP     ; 80286 and up
RETF 8     ; Far return, pop 8 bytes
           ; off the stack. Near
           ; return is a RET.
```

When determining where one routine starts and another ends, remember that right after the end of one routine, you're likely to find the start of another. If you see something that looks like epilogue code, verify it by looking for something that looks like prologue code for another function right after it.

FUNCTION RETURN VALUES In 32-bit code, functions return their values in EAX; 16-bit code uses AX for returning 16-bit values and the DX:AX combination for returning 32-bit values. If the code is written in assembly language, however, all bets are off, since the programmer can return values anywhere. For instance, KRNL386.EXE returns values in CX all over the place. One common assembler convention is that if the routine needs to return only a success or a failure code, the routine sets or clears the carry flag (CF) as appropriate. You can ferret out these routines by looking for JC and JNC instructions right after CALL instructions.

IDENTIFYING PARAMETERS If you know the parameters for the function you're taking apart, labeling them in the assembly code is particularly easy. With the exception of fast-call functions (where parameters are passed in registers), compilers always pass arguments to a function or a procedure on the stack. By adding up the sizes of each parameter passed, you can quickly locate where each parameter resides on the stack. Before showing an example of this, I need to do a quick review of compiler calling conventions used in Windows and Win32.

In 16-bit Windows code, almost all exported functions use the Pascal calling convention. In the Pascal calling conven-

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tion, the calling code pushes parameters onto the stack from the leftmost parameter to the rightmost parameter. Thus, the 16-bit code generated for a call to `foo(0x10, 0x20, 0x30)` would look something like this:

```
PUSH 0010h
PUSH 0020h
PUSH 0030h
CALL FAR PTR FOO
```

Besides specifying that parameters are passed from left to right, the Pascal calling convention also dictates that the called function removes the arguments from the stack before returning. In the above example, the foo() function needs to pop 6 bytes off the stack before it returns. It will probably do this with a `RETF 6` instruction.

The opposite of the Pascal calling convention is the C calling convention. The standard C/C++ runtime library functions use the C calling convention. In the C calling convention, parameters are passed from the rightmost to the leftmost. The code that calls the function is responsible for removing the parameters from the stack after the call returns. A call to `foo(0x10, 0x20, 0x30)` using the C calling convention would appear like this:

```
PUSH 0030h ; Parameters pushed
PUSH 0020h ; right-to-left
PUSH 0010h ;
CALL FAR PTR FOO
ADD SP,06h ; remove parameters
           ; from the stack
```

You shouldn't always expect to see an `ADD (E)SP,XX` after a C-style call. If the compiler pushed only one or two parameters, the compiler will sometimes pop the parameters into an unneeded register to remove them from the stack.

For Win32, Microsoft has adopted the *stdcall* calling convention for almost all functions that the operating system exports. The stdcall convention is a hybrid of the C and Pascal conventions. The caller pushes the parameters from right to left as in the C style. The called function cleans the parameters off the stack as the Pascal style does. (Incidentally, when you use a stdcall function with a Microsoft Win32 compiler, the compiler internally adds an `@xx` to the end of the function name. The *xx* is a string representing the number of bytes that the function expects as parameters—for instance, _GetWindowLong@8 or _PeekMessage@20. If you dump out the import libraries created for a DLL, you'll see this mangled version of the function name.)

After you've figured out which calling convention the function you're examining uses, you can determine where the parameters are on the stack. Knowing the offset of a parameter relative to the stack frame, you can look for the instructions that reference that memory location and replace the assembly-language address with a symbolic name. Having meaningful parameter names when working on a disassembly listing is immensely helpful.

After a function has executed its prologue code, the stack frame looks like this:

- parameters
- return address (placed by the CALL instruction)
- previous (E)BP (pushed by the prologue code)

The (E)BP register points to where the previous (E)BP value is saved. All of the parameters can now be accessed within the function as positive displacements from BP or EBP. This is a key point worth restating: Instructions that access memory using addresses such as [BP+*xx*] or [EBP+*xx*] are referring to the routine's parameters.

For a far 16-bit function such as those exported by Windows 3.*x*, the actual stack frame looks like this:

- parameters (starting at BP+06)
- return CS (at BP+04)
- return IP (at BP+02)
- previous BP (at BP+00)

Assuming word-size arguments and the Pascal calling convention, the last parameter to the function will be at [BP+06], the second to last parameter at [BP+08], and so on. If there are any DWORD parameters, the calculations need to be adjusted accordingly.

Let's look at a real-world example to get a better feel for stack parameters. A window procedure for a 16-bit program has the following declaration:

```
LRESULT WINAPI WndProc(HWND hWnd,
 UINT msg, WPARAM wParam, LPARAM
 lParam);
```

Inside the WndProc code, the stack frame looks like this (note the parameters have been pushed from left to right):

```
hWnd          WORD PTR [BP+0E]
msg           WORD PTR [BP+0C]
wParam        WORD PTR [BP+0A]
lParam        DWORD PTR [BP+06]
return CS     WORD PTR [BP+04]
return IP     WORD PTR [BP+02]
previous BP   WORD PTR [BP+00]
```

Armed with this knowledge, you can use your editor's search-and-replace feature to find all the references to `[BP+0E]` and replace them with the much more meaningful `[hWnd]`. Likewise, you can replace `[BP+0C]` with `[msg]` and so forth.

Now let's look at the 32-bit equivalent to the above window procedure. In Win32, all parameters are 32 bits. The return address is a 32-bit near pointer, and the code uses EBP rather than BP. And don't forget that the window procedure uses the stdcall convention, so the parameters appear in the reverse order from the equivalent 16-bit code. The stack frame for a 32-bit window procedure looks like this:

```
lParam        DWORD PTR [EBP+14]
wParam        DWORD PTR [EBP+10]
msg           DWORD PTR [EBP+0C]
hWnd          DWORD PTR [EBP+08]
return EIP    DWORD PTR [EBP+04]
previous EBP  DWORD PTR [EBP+00]
```

Now that I've described the layout of the normal stack frame for a 32-bit function, it's time to tell you the bad news that I briefly alluded to earlier. A 32-bit compiler has the option of not generating standard EBP frames; instead, the code may address the parameters with an offset from ESP (for example, [ESP+14]). If this thought alarms you, it should! The value of ESP changes throughout the function as it pushes parameters in preparation for calling other routines. Thus, an [lParam] that's at [ESP+14] early on in the function could later be found at [ESP+18] if the code pushes a DWORD onto the stack. If the code pushes a second DWORD, [lParam] would be at [ESP+1C] and so on.

If you're taking apart a function that

you don't know the parameters for, there are still some tricks you can use. You'll definitely want to figure out how many bytes of parameters the function expects. Look at the exit prologue of the function. Does it pop parameters off the stack with something like `RETF 8`? If so, you know how many bytes of parameters the function takes (in this case, 8). If the function's exit code doesn't remove anything from the stack, find a place in the code where there's a call to the function. Is the next instruction after the call something like `ADD ESP,12`? If so, the function takes 12 bytes of parameters.

Beyond knowing how many bytes of parameters a function takes, you can often glean information by studying the code that pushes the parameters onto the stack. For instance, consider the following disassembly-listing fragment from a Win32 program:

```
CALL GetFocus
PUSH EAX
CALL GetCurrentThread
PUSH EAX
CALL DoSomething
```

It's easy to see that the DoSomething function takes two parameters, an HWND and a thread HANDLE. How do you know that? Both GetFocus and GetCurrentThread are Win32 functions that return a value in EAX. After calling GetFocus, EAX holds an HWND value. After calling GetCurrentThread, EAX holds a thread HANDLE. The code pushes both of these values onto the stack and calls a function. By logical deduction, the DoSomething function expects an HWND and a HANDLE as parameters. This means you can calculate where DoSomething's parameters are on the stack and give them meaningful names.

IDENTIFYING LOCAL VARIABLES Like function parameters, a routine's local variables are also usually found on the stack. (The exception to this rule is when the compiler keeps a heavily used local variable in a register.) The key difference in distinguishing between a parameter and a local variable is that the code references local variables with a *negative* offset from the stack frame—for example, [BP-4] in 16-bit code or [EBP-4] in 32-bit code.

Unlike parameters, there's no mechanical method for determining the types, uses, and locations of local variables. Instead, you have to examine how the function's code uses a particular memory location. Sometimes you can easily determine a local variable's meaning and label it. Consider the following Win32 code snippet:

```
PUSH  DWORD PTR [EBP+08]
CALL  GetParent
MOV   [EBP-0C],EAX
```

The Win32 GetParent function takes an HWND parameter and returns that window's parent HWND in EAX. Since the code snippet copies EAX into [EBP-0C], it's obvious that [EBP-0C] is an HWND. Additionally, you can make a wild guess that this variable is probably called something like hWndParent in the original source code. Once you've gotten this far, it's time to use your editor's search-and-replace feature to change all [EBP-0C]'s to [hWndParent]. Look at your disassembly listing after you do this. Odds are it's starting to become more clear.

Sometimes it's easier to identify local variables from their use as parameters to other functions. This Win32 assembly fragment shows such an example:

```
LEA EAX,[EBP-30] ; Get value of
                 ; EBP-30h into EAX
PUSH EAX       ; Push it as an LPRECT
PUSH [EBP+08] ; HWND parameter
CALL GetWindowRect ; Call into
; USER32 to get the RECT coordinates
```

From examining the Microsoft Windows Software Development Kit (SDK), we know that GetWindowRect takes an HWND and a pointer to a RECT structure that has to be filled in. Since GetWindowRect is a stdcall function, the RECT pointer should be pushed first, followed by the HWND. In the listing, we see that for the LPRECT parameter, the code pushes an address 30h bytes below the EBP value. Therefore, there must be a local variable of type RECT at [EBP-30]. This is a bonanza of information! Since WINDEF.H contains the format of a RECT structure (four DWORDS), we can now figure out where all of the RECT's fields are on the stack:

```
RECT.left = [EBP-30]
RECT.top = [EBP-2C]
RECT.right = [EBP-28]
RECT.bottom = [EBP-24]
```

IDENTIFYING GLOBAL VARIABLES Determining that a function uses a global variable is particularly easy. Almost any memory reference that uses a hard-coded address is a global variable. Global variables don't require the assistance of registers such as EBP to address them. In 32-bit code, a global-variable reference looks something like

```
MOV EAX,[00464398]
```

If you're lucky and happen to have symbol information (debug information that somebody accidentally left in the executable, for example), the disassembler may already have replaced the `[00464398]` with the name used in the program's source. If not, you should find all the instructions that use that memory location and replace that address with the symbolic name. If you don't have symbolic information, try to figure out what the variable is used for and then make up your own name.

In 16-bit code, identifying global variables is pretty much the same as in 32-bit code, albeit with 16-bit addresses rather than 32-bit. If the code you're working with has multiple data segments, however, you'll need to be extra careful. The problem is that the same offset can be used in several data segments. When accessing global variables in a segment other than the default DGROUP, the code usually sets up a segment register (usually ES) to point to that segment. The code then accesses variables in the segment with hard-coded offsets—for instance,

```
MOV AX,ES:[001C]
```

The lesson here is to be careful when replacing global-variable addresses with symbolic names. Make sure the segment register really is pointing to the segment that you think it is. Otherwise, you run the risk of labeling a global variable with the wrong name.

If you have symbolic information for an executable file but encounter a mem-

ory location that's not in the list of global variables, there are two probable explanations. First, that memory location might be used for a static variable. If your symbol information includes only public symbols, the variable won't show up in the list. The other possibility is that you're looking at a member of a structure or an array. For instance, a 16-bit program has a global variable `MSG MyMsg` that ends up in the program's DGROUP segment at offset 0364h. The wParam field lies 4 bytes into the MSG structure. `MyMsg.wParam` will therefore be at offset 0368h in the data segment. Symbol information generated for this executable will include a public symbol called `MyMsg` at offset 0364h but will contain nothing about offset 0368h. This is where experience comes in. You might guess that `MyMsg` is a structure of type MSG. Working from that assumption, you would figure out the addresses of the individual structure members and look for code that uses those memory locations. If the code uses the memory locations in a manner consistent with your hypothesis, you've probably guessed correctly.

IDENTIFYING STRING LITERALS Many API functions take strings as parameters. By matching up the ASCII strings with the functions that use them, you can often get a much better idea of what the code is doing. For instance, in a 16-bit program, you might encounter

```
PUSH DS
PUSH 0437
CALL GETMODULEHANDLE
```

Turning to your trusty API documentation, you see that the GetModuleHandle function takes one argument, an LPSTR. The PUSH instructions are pushing the address of a string onto the stack as the parameter to GetModuleHandle. At address DS:0437, therefore, there must be a null-terminated string (for example, "USER"). If your disassembler has done a hexadecimal and ASCII dump of the file's data sections, go to the address and retrieve the string. Back in the code that referenced the string literal, make a comment that includes the retrieved string—for instance, you would use

```
PUSH DS
PUSH 0437 ; = "USER"
CALL GETMODULEHANDLE
```

If the code you're disassembling uses a lot of string literals, you'll be amazed how much clearer it becomes after you do this.

IDENTIFYING IF STATEMENTS The simplest type of conditional execution code to figure out is a simple `if` statement:

```
if ( some test ) {
 do some sequence of code
}
```

Viewed from the disassembly-listing level, there are three primary types of tests that you encounter:

- equality: `if (a == b)`, `if (a != b)`
- Boolean TRUE/FALSE: `if (a)`, `if (!a)`
- bitfield tests: `if ( a & 0x0040 )`

Although compilers generate different code sequences for each type of test, the goal in each case is to set or clear the CPU's zero flag (ZF). After setting or clearing the zero flag, the code uses the JZ or JNZ conditional branch instructions either to execute the next section of code or to skip over it. JZ stands for "jump if zero" while JNZ means "jump if not zero." In the spirit of keeping assembly language confusing, the JZ instruction mnemonic can also be expressed as JE (jump if equal). Likewise, JNZ can also be coded as JNE (jump if not equal).

The idea behind the "test, then conditionally jump" model is this: If the test expression resolves to FALSE, the CPU takes the conditional jump, and the code inside the {}'s or the BEGIN/END block doesn't get executed. If the expression evaluates to TRUE, the conditional jump isn't taken, and control falls into the code inside the {} block in C or between a BEGIN/END block in Pascal.

Warning: What I've just described here is the simple version of what occurs. In the real world, the generated code might be more complex. In 16-bit code, there might be a JZ or JNZ instruction whose only job is to jump over a regular JMP statement. The JMP statement will jump to the end of the conditional block. This happens if the code inside the `if` block was longer than 127 bytes, the limit of a 16-bit JE or JNE instruction.

For equality tests, compilers use the CMP instruction. This snippet of output produced with `DUMPBIN /DISASM` shows an example:

```
0000101E: cmp dword ptr [ebp-04],04
00001022: jne 0000102E
00001028: inc byte ptr [ebp-04]
0000102B: inc byte ptr [ebp-08]
0000102E: ...
```

The first instruction compares the DWORD at [EBP-04] with the value 4. If they're the same, the CMP instruction sets the zero flag; otherwise, it clears the zero flag. The next instruction (JNE) jumps over the code that follows but only if the zero flag was cleared. Therefore, the two INC instructions execute only if the zero flag was set. The zero flag could be set only if [EBP-04] was equal to 4. Expressed in C code, the above snippet could look something like this:

```
if ( SomeVariable1 == 4 )
{
 SomeVariable1++; // INC [EBP-04]
 SomeVariable2++; // INC [EBP=08]
}
```

In 16-bit code, when the code inside the {}'s is greater than 128 bytes in length, the above expression could be

```
        ; Is the value 4?
0176: CMP WORD PTR [BP-02],04
        ; Yes? jump to {} code
017A: JE 017F
        ; No? Jump around {} code
017C: JMP 085A
017F: ... ; start of the {} code
```

When the expression in the `if` statement is concerned only with whether the expression is TRUE or FALSE, the compiler has alternative code-generation options. In some cases, the generated code can look like the `if` statement described earlier. For example, the expression `if (MyVariable)` could also be written as `if (MyVariable != 0)`. Another sequence occurs when the expression's value is in a register. When this happens, the compiler can use a smaller instruction to determine whether the value is TRUE (nonzero) or FALSE (0). The shorter in-

struction is an `OR register,register` instruction, like this:

```
0000102E: call  00001000
00001033: or    eax,eax
00001035: je    0000103E
0000103B: inc   byte ptr [ebp-04]
0000103E: ...
```

In this code, the first instruction calls a function that returns its value in EAX. Rather than using 3 bytes with a `CMP EAX,0`, the compiler uses an OR instruction. The OR instruction does a logical OR on all the bits in EAX. Only if none of them are set (EAX == 0) will the zero flag be set.

The third instruction sequence you'll see generated for `if` statements occurs when individual bits are involved. Many WORDs and DWORDs in Windows programming are composed of a set of 1-bit flags, such as the WS_*xxx* style bits you pass to CreateWindow. Code that needs to test whether a bit is set uses the language's bitwise AND operator (in C, the & operator). Consider the following C fragment:

```
DWORD winFlags = GetWinFlags();
if ( winFlags & WF_CPU386 )
 is386 = TRUE;
```

The assembly code generated for the `if` statement looks like this:

```
0000102E: test byte ptr [ebp-08],04
00001032: je 0000103F
00001038: mov dword ptr [ebp-0C],
          00000001
0000103F: ....
```

where 0004h corresponds to WF_CPU386. The first instruction uses the CPU's TEST instruction to see whether the bit representing the value 4 is set. The TEST instruction performs a logical AND on the corresponding bits in the two operands but doesn't overwrite either of the operands. Instead, TEST sets the zero flag if the result doesn't have any bits set. If any bits were set, TEST clears the zero flag. If the bit representing the value 4 was set in [EBP-08], the zero flag will be clear, the JE instruction won't jump, and the DWORD at [EBP-0C] will be incremented.

Only slightly more complicated than an `if` statement is an `if-else` statement. Consider the following elaboration of a previous example:

```
if ( i == 4 )
{
   i++;
   j++;
}
else
j--;
```

The compiler generates the following code:

```
0000101E: cmp dword ptr [ebp-04],04
00001022: jne 00001033
00001028: inc byte ptr [ebp-04]
0000102B: inc byte ptr [ebp-08]
0000102E: jmp 00001036
00001033: dec byte ptr [ebp-08]
00001036: ...
```

The first two instructions look identical to the code for a plain `if` statement. The JMP instruction a bit later is the key. After executing the code when the expression is true, this JMP instruction skips over the code generated for the `else` clause. The target address of the JMP instruction identifies where the `else` clause's code ends. The key things to look for in identifying `if-else` statements are these: Does the initial JE/JNE instruction jump to an instruction that's immediately after a JMP instruction? Does the JMP instruction transfer to a higher address (that is, does it goes forward in memory rather than backward)?

I've covered only the basics of branching constructs here. There are certainly more complicated things you will encounter. I haven't covered `if` statements with multiple conditions, `for` loops, `while` loops, and other branching constructs. Almost everything you'll encounter, however, can be broken down into combinations and variations of the code sequences that I've shown here.

PUTTING IT ALL TOGETHER After you've done all the mechanical portions of the disassembly process, it's time to take the intermediate results and work them into lines of understandable C code. For example, you can replace the following:

```
PUSH   DS
PUSH   0437 ; DS:0437 = "USER"
CALL   GETMODULEHANDLE
MOV    SI,AX
```

with its C equivalent:

```
SomeLocalVariable = GetModuleHandle
( "USER" );
```

Not every group of assembly instructions converts so easily. There are no hard-and-fast rules. This is where experience and gut instincts come in. Try to put yourself in the position of the programmer who wrote the code. Look for common patterns that might establish a coding convention. One useful technique for learning the subtleties of this process is to disassemble and analyze your own programs. This helps get a feel for how a compiler expresses common high-level–language expressions in assembly language.

FURTHER READING If you'd like to delve deeper into the topic of reverse engineering through disassembly, check out the following books:

- *Undocumented DOS,* Second Edition, by Andrew Schulman, Ralf Brown, David Maxey, Raymond J. Michels, and Jim Kyle, Addison-Wesley. ISBN: 0-201-63287-X.
- *Undocumented Windows,* by Andrew Schulman, David Maxey, and Matt Pietrek, Addison-Wesley. ISBN: 0-201-60834-0.
- *Windows Internals,* by Matt Pietrek, Addison-Wesley. ISBN: 0-201-62217-3.

NOT JUST FOR WIZARDS Disassembly is messy, imprecise, and frustrating work. On the other hand, it can be an extremely valuable skill that few programmers take the time to master. If you're not already using these tools and techniques, I hope I've taken away the mystique. If you have a firm grounding in hardware and operating-system basics, disassembly can be just another part of your toolbox rather than something reserved for programming wizards. □

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Utilities

BY DOUGLAS BOLING

More Power for WINCMD

Last year, I wrote WINCMD, a batch-file language and interpreter for Microsoft Windows (for more information, see *PC Magazine,* April 27, 1993). WINCMD has become a popular addition to the library of *PC Magazine* utilities. Along with this popularity have come hundreds of requests for new functions and features. This issue's utility, WCL2 (for "WINCMD Library 2"), is a response to many of those requests.

WCL2 provides over 20 new functions for WINCMD. Among them are functions to read and write .INI files, parse filenames, and display the Windows common dialog boxes for File|Open and File| Save. The goal of WCL2 is to add functions that fill in the gaps left by WINCMD and the first function library, WCLIB (*PC Magazine,* May 25, 1993).

WCL2 requires a new version of WINCMD: WINCMD, Version 1.3. I designed WINCMD to be extensible without revisions to the basic program, but bugs in the original code necessitated this upgrade to WINCMD. To add a little sugar to the medicine of the WINCMD upgrade, I have added some new statements to the WINCMD language that should be popular among WINCMD fans. For details on these statements and other changes to WINCMD, read the accompanying sidebar "New and Improved: WINCMD 1.3 and WCLIB 1.1."

If you are interested in WCL2 and the new WINCMD, you may obtain them without charge from PC MagNet or by mail. Read the sidebar "Guide to Our Utilities & How to Get Them" for details. Both the executable files WCL2.WCL and WINCMD.EXE and their C-language source code files are available.

To install WCL2, just copy the file WCL2.WCL into the same directory where WINCMD.EXE is stored. Upgrading to Version 1.3 of WINCMD is equally simple: Just copy the new WINCMD .EXE over the old one. WINCMD 1.3 will run all your old .WCM programs. WCL2 does not replace WCLIB, my first WINCMD function library; both can be used together.

You can start WINCMD either by using the File | Run menu selection in Program Manager or by double-clicking on a WINCMD icon created in the Program Manager. When launched, WINCMD will load the WCL2 library (and WCLIB, if present) automatically. You can confirm that WCL2 is loaded by selecting the Help menu in the WINCMD window; if WCL2 is loaded, you'll see an About WCL2 menu item in the Help menu. The new functions of WCL2 also will be listed in the WINCMD Help dialog.

Top 10 Utilities

Rank	Utility
1	**PRN2FL** - *Captures printer output*
2	**MONTOR** - *Monitors system resources*
3	**PCDEZP** - *Extracts .ZIP files*
4	**INPUTT** - *Text-input batch files*
5	**WTIME** - *Keeps PC clock accurate*
6	**BAT2EX** - *Compiles batch files*
7	**CONFIX** - *Issues boot-time commands*
8	**FONED1** - *Creates mnemonic phone numbers*
9	**TED** - *Tiny screen editor*
10	**PCMCVT** - *Strips word processing codes*

This list is based on the total number of downloads each utility has had on PC MagNet over the past 12 months. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "Guide to Our Utilities & How to Get Them."

THE NEW FUNCTIONS The functions added by WCL2 are shown in Figure 1. The first group of functions is string functions, designed to make working with text strings easier. The Val and Chr functions work like the Val and Chr$ functions in BASIC. Val returns the number associated with the ASCII character passed to the function. For example, Val(A) returns the number 65, which is the ASCII code for the letter "A". If you pass a multicharacter string, the first character will be used.

The Chr function is just the opposite of Val; it converts the passed number to its associated ASCII character. For example, Chr(72) returns the letter "H". Val and Chr are handy when you need to write your own string processing functions. When you use these two functions, any character can be converted to a number, processed, and converted back to a character.

The Reverse function reverses the order of the characters in a string. For example, Reverse("abcdefghi") would return the string "ihgfedcba". Since WINCMD does not differentiate between numbers and text strings, Reverse can also be used to reverse the order of digits in a number. For example, the call Reverse(12345) will return 54321. Using Reverse in combination with the WINCMD functions SubStr and InStr, you can process strings from back to front instead of front to back.

The InStr function searches a string for the first occurrence of a substring. If the substring is found in the string, InStr returns the zero-based index of the start of the substring in the original string. For example, InStr ("qwerty", "er") will return the value 2. If the substring is not found, InStr returns -1.

InStr is not case-sensitive, so the call InStr ("abcdef",DEF) will find the string "DEF" in "abcdef" and return the number 3. InStr is handy for parsing long strings, especially when it's used with SUBSTR.

The FullPath function returns a fully specified path and filename from a relative filename. If you pass FullPath a filename such as WINCMD.EXE, it attaches the current drive letter and path to the name and returns C:\PCMAG\UTIL \WINCMD.EXE. The filename passed to FullPath can use partial paths, as in

WCL2's New WINCMD Functions

String functions	
Val (*character*)	Returns the ASCII number for a character
Chr (*number*)	Returns the ASCII character for a number
InStr (*string, substring*)	Returns the index in string of substring
Reverse (*string*)	Returns the string in reverse order
Filename functions	
FullPath (*filename*)	Returns the full path of a file
GetFileDrive (*filename*)	Returns the drive of a file
GetFileDir (*filename*)	Returns the directory of a file
GetFilePath (*filename*)	Returns the drive and directory of a file
GetFileName (*filename*)	Returns the name of a file
GetFileExt (*filename*)	Returns the extension of a file
File-processing functions	
FileOpenBox (*filter name, filter filespec*)	Displays a File Open dialog
FileSaveBox (*filter name, filter filespec*)	Displays a File Save dialog
Keyboard-monitoring functions	
IsKeyDown (*sendkey key*)	Returns nonzero if key is being pressed
IsKeyShifted (*sendkey key*)	Returns nonzero if key is shifted
Window functions	
SetWindowText (*window handle, text*)	Sets the title text of a window
ShowWindow (*window handle, show param*)	Hides a window or makes it visible values for *show param*: WINDOW_SHOW Show window WINDOW_HIDE Hide window
IsRunning (*program name*)	Returns nonzero if program is currently running
Date and time functions	
GetDate	Returns the system date (mm/dd/yy)
GetTime	Returns the system time (hh:mm:ss)
.INI file functions	
ReadINIData (*section, key, default value, .INI filename*)	Returns data from an .INI file
WriteINIData (*section, key, default value, .INI filename*)	Writes data to an .INI file

Figure 1: **The second WINCMD add-on library adds functions in a variety of categories.**

..\TEMP\WINCMD.EXE. In this case, FullPath gets the current directory, backs up one directory because of the . . , and then adds the TEMP directory to the path. If the current drive is F: and the directory is \PROJECTS\WINCMD, FullPath would return F:\PROJECTS \TEMP\WINCMD.EXE.

FullPath is handy when you need to parse a filename entered by a user. With FullPath, WINCMD programs can parse filenames without having to worry about relative directories or the lack of a drive letter.

Note that the path and filename a user enters will be returned in a fully specified format even if the filename doesn't exist. The purpose of FullPath is to fill out a file's path information, not to verify the file's existence. To determine if a file and path exist, use the WINCMD function FileExist, which is part of WCLIB.

The GetFileDrive, GetFileDir, GetFileName, and GetFileExt functions are designed to ease the burden of parsing filenames. GetFileDrive returns the drive on which a file is located. The filename passed to GetFileDrive or any of the related functions does not have to be specified in its entirety. If only a filename without a drive is passed, GetFileDrive will return the current default drive. If a drive is specified in a filename, that drive letter is returned. The functions GetFileDir, GetFileName, and GetFileExt return the path, name, and extension of the passed filename. As with GetFileDrive, these other functions do not need a fully specified path. The last member of this family, GetFilePath, returns both the drive and the directory of a file.

Since many users write WINCMD programs that process files, WCL2 includes two functions that make asking for those filenames more user-friendly. The FileOpenBox function displays Windows' File Open dialog box used by most Windows programs, including WINCMD.

One feature of the File Open dialog box is a filter that allows the dialog to display only those files with a particular extension. Users can change this by selecting from the combo box in the lower-left-hand corner of the dialog. When using the FileOpenBox function, a WINCMD program can specify the filter to be used by passing two strings: a description of the filter and the actual DOS file filter with wildcards.

For example, to ask the user to select from bitmap files that have the extension .BMP, the call would be

```
FileOpenBox ("Bitmap Files", "*.BMP")
```

When the File Open dialog box is displayed, the filter *.BMP will be in the filename selection, and only files with a .BMP extension will be displayed in the file list.

You can combine multiple DOS filters by using a semicolon as a separator. For example, to list run-length-encoded bitmaps with the file extension .RLE along with .BMP files, the call would be

```
FileOpenBox ("Bitmap Files",
 "*.BMP;*.RLE")
```

The FileOpenBox function also adds the selection "All Files" to the filter list. If the user selects a file, FileOpenBox returns the filename; if the user clicks the Cancel button, FileOpenBox returns -1.

The FileOpenBox function does not check to see whether the file exists before returning to the WINCMD program. To warn a user that a file does not exist, you could use the following code fragment:

```
NeedFileName = 1
while (NeedFileName) do
   Name = FileOpenBox ("Text Files",
   "*.txt")
   if (Name = -1)
      NeedFileName = 0
   else do
      if (NOT FileExist (Name)) do
        rc = MsgBox ("The file "
        +name+" does not exist!
        Continue?", "WINCMD",
        MB_YESNO);
      if (rc = ANS_YES)
         NeedFileName = 0
   end
end
```

The FileSaveBox function displays Windows' File Save dialog box. FileSaveBox allows a filename filter to be specified in the same manner as in FileOpenBox. The function returns either the filename selected by the user or -1 if the Cancel button was clicked.

The next two functions, IsKeyDown and IsKeyShifted, assist WINCMD programs in monitoring the keyboard. The IsKeyDown function returns a nonzero value if the user is currently pressing the specified key. The function takes one pa-

What's New in WINCMD 1.3 And WCLIB 1.1

The new version of WINCMD, available now on PC MagNet, is much improved over the original WINCMD. This version not only has some new and quite useful statements, but other areas of the program have been improved as well. Readers using an earlier version of WINCMD will definitely want to download WINCMD, Version 1.3.

Improvements to WINCMD started with WINCMD 1.1. In Version 1.3, I added a help screen that lists the syntax of the WINCMD language, as well as all the functions available to WINCMD programs. This help screen automatically queries WINCMD function libraries such as WCLIB and WCL2 for their functions as well, so the help screen is continually up to date. In WINCMD 1.1, I also added a GETENVVAR function, which returns the value of environment variables.

Version 1.2 of WINCMD was a maintenance release that corrected a number of nagging problems that WINCMD users were seeing. No new functions were added in 1.2.

The most dramatic changes are in Version 1.3, which adds three new statements (OnDrop, LaunchSpecial, and ClearOutput) and two new functions (GetDropCnt and GetDropFile).

LaunchSpecial, the most requested improvement to WINCMD, allows a WINCMD program to control how a launched program is displayed and can force WINCMD to wait until the launched program completes before continuing on to the next statement in the program. One warning: LaunchSpecial will not work if your _DEFAULT .PIF does not have Background Execution checked.

The syntax of LaunchSpecial is simple; just use the statement LaunchSpecial followed by any launch conditions and then the command you would normally place in a WINCMD program. For example, in order to start Microsoft Word for Windows and wait until it completes before continuing, the statement would look like

```
LaunchSpecial (LC_WAIT) WINWORD
```

The parameter LC_WAIT can be combined with the launch parameters LC_MAXIMIZE, LC_MINIMIZE, or LC_BACKGROUND using the bitwise OR operator ORB.

This statement has a number of valuable uses, some of which are demonstrated in the example program, TrashCan. When used with the LC_WAIT parameter, LaunchSpecial can return the exit code the child program returns to DOS and Windows when it completes. Many programs use exit codes, which can range from 0 to 255, to return valuable information about the success or failure of the program. WINCMD programs can access this return value by checking the predefined variable RETURNCODE. WINCMD sets RETURNCODE with the return-code value of the last program executed with LaunchSpecial.

It is possible to force WINCMD to continue to the next statement even if the program being waited for is still running. Just click on WINCMD's Run button, and your WINCMD program will continue executing. If you force WINCMD to stop waiting, the value of RETURNCODE will be greater than 65,535—an impossible value if the program had actually completed.

The OnDrop statement allows WINCMD programs to take advantage of a drag-and-drop interface. The syntax of OnDrop is

```
OnDrop {statement}
```

where *statement* is any WINCMD statement. Normally the statement will be a call to a user-defined WINCMD function, but it can also be any other valid WINCMD statement, including a DO-END block.

When WINCMD executes an OnDrop statement, the statement on the OnDrop line is not immediately executed. The program continues to the statement after OnDrop, and Windows is informed that the WINCMD window can accept dropped files. When a user drops a file on the WINCMD window, WINCMD finishes executing the line it is currently on, and then executes the statement on the OnDrop line. When the OnDrop statement has completed, WINCMD returns to the next line beyond the last one it had executed before the files were dropped. If the statement on the OnDrop line is a call to a user-defined function, the complete function is executed when a file is dropped. To disable the OnDrop statement, just use OnDrop without any trailing statement. WINCMD will inform Windows that it no longer accepts drag-and-drop files.

Two functions assist OnDrop in processing the dropped files. GetDropCnt returns the number of files or directories that were dropped on the WINCMD window at any one time. Note that this is value is not cumulative; if five files are dropped, then one file is dropped, GetDropCnt will return a value of 1. GetDropCnt takes no parameters.

GetDropFile returns the name of a file dropped on the window. GetDropFile takes one parameter: the zero-based index into the number of files dropped. For example, if three files were dropped, GetDropFile(0) would return the first file dropped and GetDropFile(2) would return the third file dropped.

The simple example of OnDrop

shown below prints a list of the files dropped on the WINCMD window:

```
// Tell Windows we will accept
// dropped files
OnDrop DisplayFiles()
// Wait for 1 minute for files to
// be dropped
Delay (60000)
// Unregister OnDrop function
OnDrop
//Terminate the program
exit
-----------------------------
// This routine will be called
// when files are dropped.
-----------------------------
DisplayFiles:
   count = GetDropCount()
   while (count > 0) do
      count = count - 1
      say GetDropFile (count)
   end
return
```

ClearOutput is the last and simplest of the new statements. ClearOutput clears the WINCMD output window used by the PRINT and SAY functions. The idea is that some users may want to use the output window to display data, so ClearOutput provides an easy way to reinitialize the WINCMD output window.

There have also been improvements to WCLIB. Version 1.1 adds error checking of file operations and some new constants that should help with the FileOpen command, which can easily fail depending on the state of the file. In the past, WINCMD programmers had to remember numeric values to tell the FileOpen whether a file should be opened in read-only or read/write mode and whether a file should be created if it didn't exist before. Now these constants are automatically available in the FILE_READONLY, FILE_ READWRITE, and FILE_CREATE variables. The FILE_CREATE constant can be combined with the FILE_READONLY or FILE_ READWRITE constants using the ORB operator. □

rameter: a character in the WINCMD SendKeys format, which is a string of characters that specifies a key.

For the most part, a character in SendKeys format is simply the character in quotation marks. For example, to get the state of the A key, the call would be IsKeyDown("A"). For some keys, such as the Tab key or the Backspace key, however, a simple character will not do. For these keys, a string is passed to the function enclosed in curly brackets. To determine if the Tab key is down, for example, the call would be IsKeyDown ("{tab}"). A complete list of tags for SendKeys characters can be found in the Help window of WINCMD.

You can combine calls to IsKeyDown in order to make a WINCMD program act on a hotkey. For example, to have your WINCMD program leap into action at the press of Ctrl-F9, you could loop on the statement

```
If (IsKeyDown("{F9}") AND IsKeyDown
    ("{control}")) do

   hotkey stuff...

end
```

Since IsKeyDown and IsKeyShifted work on keys, not characters, not every character is accepted by these functions. You should make it a general rule to pass the unshifted character to these functions. In the case of letters of the alphabet, this is not a requirement, but for keys that contain two unrelated characters, such as the equal sign and the plus sign, use the unshifted character to specify the key.

The IsKeyShifted function determines whether a key has been pressed an odd number of times since the system booted up. While you can use this function to determine if the A key has been pressed an odd number of times, the real value of the function is to check the CapsLock, NumLock, and Insert keys. This function will return a nonzero value if the number of keystrokes is odd.

The ShowWindow function allows a WINCMD program to show or hide a window on the desktop. The first parameter to this function is the handle of the window on which to operate. The second and final parameter is a flag: either WINDOW_SHOW or WINDOW_HIDE. To make a window invisible on the desktop, the command would be

```
ShowWindow (handle, WINDOW_HIDE)
```

ShowWindow is handy if you want your WINCMD program to be stealthy. With ShowWindow, you can hide your WINCMD window when it's waiting for an event or busy performing a task.

The SetWindowText function allows a WINCMD program to set the title text of a window. The main use of this function is to change the title text of the WINCMD window, but it can be used to set the title text of other windows on the desktop. The two parameters to this function are the window handle and the new title text. For example, to change the title bar of the WINCMD window to "Hi Bob!", the command would be

```
SetWindowText (hMain, "Hi Bob!")
```

Notice the use of the predefined variable hMain, which always contains the handle of the WINCMD window.

The IsRunning function indicates if a particular program is currently running on the desktop. The function has one argument—the name of the program—and returns a nonzero value if that program is running. The program name can either include a path or not. If a path is included, the program and path must be an exact match to the program running. If no path is specified, any program whose name matches the filename will be detected. The wildcard characters * and ? can be used in the program name but not in the path.

For example, the command IsRunning ("winword.exe") will return a nonzero value if Microsoft Word for Windows is running. Notice that the example did not specify a path. Had a path been specified, as in

```
IsRunning ("d:\editors\winword
           \winword.exe")
```

the function would only find WinWord if the .EXE file was in the D:\EDITORS \WINWORD directory. The example could have specified the extension .EXE by using the call IsRunning ("winword.*"). But in the unusual case that a program such as WINWORD.COM was

running in a DOS box, the function would return "found" even if WINWORD.EXE was not running.

IsRunning is smart enough to check the names of programs running in DOS boxes. But if a DOS box is running a program with a .PIF file, the name of the .PIF file will be checked instead of the name of the program that the .PIF file is running. Similarly, if a batch file is used to launch the program, the batch filename is the one checked, not the program started by the batch.

IsRunning is powerful when used with the new LaunchSpecial statement in WINCMD 1.3. With IsRunning, a WINCMD program can determine what programs are and aren't running when it starts. This lets you check for a program, and then launch it if necessary.

The GetDate and GetTime functions return the current date and time. Neither of these functions take any parameters. The date and time are returned in the *mm/dd/yy* and the *hh:mm:ss* formats. Hours are in 24-hour format, so if it is 6:00 P.M., GetTime will return 18 in the hours field. Both functions display leading 0s for single digits. For example, March 2, 1994, would be displayed as 03/02/94. This allows easy parsing of the date and time values using the SUBSTR function.

The last two functions new to WCL2—ReadINIData and WriteINIData—provide WINCMD programs with the ability to read and write .INI file data. ReadINIData takes four parameters: the section name in the .INI file to be read, the name of the variable to be read (the *key*), the default value that will be returned if the section or key cannot be found, and the name of the .INI file itself. WriteINIData also takes four parameters: the section name, the key name, the value to write to the .INI file, and the name of the .INI file to write.

The primary purpose of .INI files is to save data when a program is not running, but these files do have other uses. Since Windows keeps much of its configuration data in WIN.INI and SYSTEM.INI, these WCL2 .INI functions can be used to read and modify your Windows configuration. Of course, you will want to be extremely careful when modifying your Windows configuration, since writing the wrong values to these critical files can be disastrous to your Windows setup!

USING WCL2 WITH WINCMD AND WCLIB Now that there are two function libraries—WCLIB and WCL—and four versions of WINCMD (Versions 1.0, 1.1, 1.2, and 1.3), WINCMD program writers need to take care to detect what environment their programs are running in. Since WINCMD 1.1, a predefined variable called WINCMDVER has contained the version number of WINCMD. To include a test for 1.0, which did not have this variable, a short function such as the following can be written:

```
GetWINCMDVer:
   if (WINCMDVER = "WINCMDVER")
      WINCMDVER = 10
   return WINCMDVER
```

the function would then be called this way:

```
version = GetWINCMDVer()
```

You can determine if a function library is present by using the LIBVER command. LIBVER's single parameter is the name of a function library, such as WCLIB or WCL2. The function returns the version number of the library or 0 if the library is not loaded.

An example of a routine that uses these variables and functions to verify the necessary components is shown in Figure 2. The routine, called CheckVers, takes a variable number of arguments; the first is the name of the WINCMD program being executed. The program name can be determined in the main body of a WINCMD program with the call Arg(0). The second parameter passed is the required version of WINCMD. To require WINCMD 1.3, for example, pass the value 13 in this parameter. The remaining parameters are passed in pairs—first the name of the required library, and then the version of the necessary library. In this example, we require WCLIB 1.0 and WCL2 1.0, so the call to CheckVers would look like

```
if (CheckVers(arg(0), 13, wclib,
    10, wcl2, 10))
   exit 1
```

Since CheckVers returns 1 if any of the components cannot be found, a simple IF statement can be used to detect this condition, and you can end the program with an EXIT statement.

TRASHCAN DEMONSTRATION The example program TrashCan (distributed with WCL2) showcases many of the new functions of WCL2 and the enhancements to WINCMD. TrashCan is a WINCMD program that implements the classic drag-and-drop trash can popularized by the Macintosh. Files dropped on the TrashCan icon are moved to a Save directory. TrashCan never deletes the files in the Save directory, although the

```
//-----------------------------------------------------------------------------
// CheckVers - Checks the necessary version WINCMD numbers.  Returns
// 0 if all versions ok.
// arg(1) - Name of program
// arg(2) - required version of WINCMD
// arg(n+3) - Name of required function library
// arg(n+4) - required version of library passed in arg (n+3)
//-----------------------------------------------------------------------------
CheckVers:
if (WINCMDVER < arg(2)) do
   errver = "version "+(arg(1) / 10)+("."+arg(1) mod 10)
   MsgBox ("You need "errver" of WINCMD.EXE to run "+arg(1), "WinCmd",0)
   return 1
end
count = 3
while (count < arg()) do
   if (LibVer(arg(count)) < arg(count+1)) do
      errver = "version "+(arg(count+1) / 10)+("."+arg(count+1) mod 10)
      MsgBox ("You need "+errver+" of the WinCmd library "+arg(count)+" to run "+arg(1),"WinCmd",0)
      return 1
   end
   count = count + 2
end
return 0
```

Figure 2: **CheckVers is a routine that checks the version of WINCMD, as well as the versions of the WINCMD add-on libraries.**

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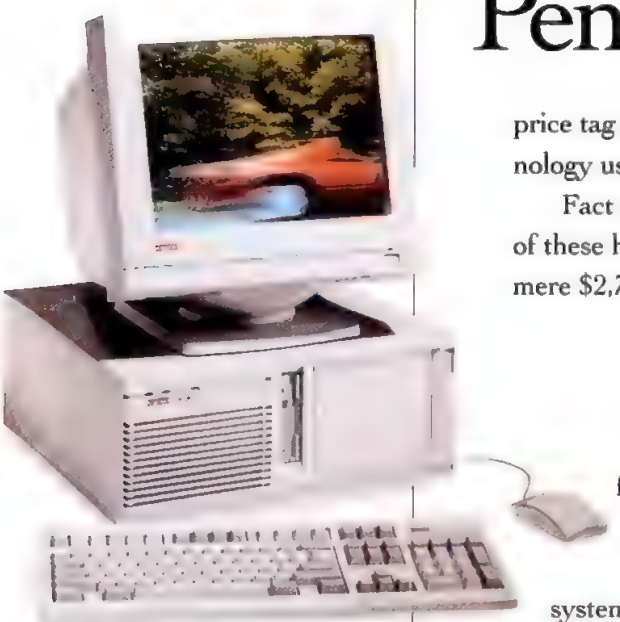

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program could be modified to do so.

At about 250 lines, TrashCan is a moderately complex WINCMD program that centers around the new OnDrop statement. The new LaunchSpecial statement is used to synchronize running the DOS commands that perform the critical functions of TrashCan. Various other new WCL2 functions are used to aid in filename parsing and other necessary tasks.

TrashCan begins with a call to the same CheckVers function discussed earlier. If all the files are up to date, TrashCan calls the GetSaveDir function to get the path of the Save directory. GetSaveDir attempts to read the directory from the TRASHCAN.INI file. If the .INI file does not exist, a dialog box is presented to the user to ask for the directory. Once the directory is returned from either the user or the .INI file, a quick check is made to ensure that the directory exists.

The technique used to check for a directory is borrowed from *PC Magazine*'s own batch-file guru, Neil Rubenking. All that is required is to append the name of the null device (NUL) to the end of the path and check to see if DOS thinks the resulting filename exists. Instead of the IF EXIST line used in standard .BAT files, GetSaveDir uses the FILEEXIST function available in WCLIB. If the directory read from the .INI file does not exist, or if the directory returned from the user could not be created, GetSaveDir displays an error box and terminates the program. This technique works under plain, nonnetworked DOS. Under DR DOS 6.0 and some network operating systems, the FILEEXIST test will always return TRUE for the null device even if the directory does not exist.

The heart of TrashCan is the short loop

```
// Main program loop
while (1) do
   // Fill in output box with list
   // of current files in trash dir
   count = GetSaveFileCnt(TrashDir)
   // Set drop icon
   if (count)
      seticon (hMain, hIconF)
   else
      seticon (hMain, hIconE)
   // Wait till something's dropped
   stop
end
```

In this loop, TrashCan calls the GetSaveFileCnt routine to determine if any files are in the Save directory. Depending on whether any files are in the directory, one of two icons are displayed. After the icon or icons have been set, the program halts with a STOP statement.

The STOP statement is a bit deceiving. Unlike an EXIT statement, STOP does not terminate the program; instead, the program is stopped in place. Stopping a WINCMD program is much better than a continuous loop, because a stopped WINCMD program does not take up any valuable processor time.

Even with the program stopped, the OnDrop statement will still take control and execute the remainder of its line if a file is dropped on the TrashCan icon. When a file is dropped, WINCMD executes the remainder of the OnDrop line—in this case, the call to CopyFunc. When CopyFunc returns, WINCMD continues execution at the statement after the STOP. The WHILE loop returns WINCMD to check the number of files in the Save directory, and then executes the STOP statement to await another file drop.

CopyFunc's job is to query the names of the dropped files and directories using the GetDropFile function, and then move them into the Save directory. If the returned name is a file, the process is simple: Just copy the file into the Save directory and erase the original. This function is performed by the function MoveFile. Users of DOS 6.*x* can modify MoveFile to use a single MOVE statement instead of the COPY and DEL used in this example.

If the dropped item is a directory instead of a file, the process is a little more complex. For a directory, TrashCan must determine the names of each file and subdirectory inside the directory to be moved, and then process each file and directory individually. This is where the LaunchSpecial statement comes into play. It is standard batch file practice to redirect the output of a DOS command to a file, and then have the batch file process the redirected data contained in that file. Before WINCMD 1.3 and the new LaunchSpecial statement, this was not easy to do, since WINCMD did not wait for a DOS command (or a program) to complete before continuing on to the next statement in the WINCMD program. With LaunchSpecial, a WINCMD program will wait until a task is complete. In this case, the MoveDir function redirects the DIR command output to a file, and then reads that file (using repeated calls to the WCLIB function FileReadLine) to determine each of the filenames in the directory.

A problem arises when the directory being moved contains subdirectories. When a subdirectory is found, we need to call the MoveDir function from *within* MoveDir. The technique in which a function calls itself is called *recursion*, and while incredibly powerful, it is difficult to implement—especially in a language such as WINCMD where all variables are global.

Looking carefully at the MoveDir function of TrashCan, you can see that while I use a number of variables as temporary place holders, the only variable that is needed both before and after the recursive call to MoveDir is the handle of the redirected data file—appropriately named Handle. The problem is that if MoveDir calls itself, the value in Handle is overwritten by the second call. To avoid this, the following little trick is used to save the value of Handle in a string called rArray:

```
//Save handle as string in rArray
rArray = "#"+handle+"$"+rArray
//Recurse calling this routine again
rc = movedir (filename)
//Restore variables
rArray = substr (rArray, 1, 1000)
//Strip off leading #...
//Get back handle value
handle = substr (rArray, 0,
instr(rArray,"$"))
//Strip handle from rArray
rArray = substr (rArray, instr
(rArray,"$")+1,1000)
```

The key to this trick is that WINCMD does not differentiate between numbers and strings. A number can be appended to a string, and conversely, the numeric value of a string can be used in any mathematical operation. In the code fragment above, the plus signs are actually appending parts of a string that is then assigned to rArray. The SubStr function is used to break apart a string into smaller substrings.

The rArray variable is nothing more than a string that contains the recursive values of Handle, each value separated by the characters # and $. (I could have used

any nondigit characters to separate the Handle values.) Once Handle is saved in rArray, MoveDir can safely be called. If the recursive call to MoveDir must move a directory, and therefore call itself a second time, the new value of Handle is appended to rArray. The old value is not lost, because Handle is not assigned to rArray; the old value is *appended* to the existing value in rArray.

When the recursive call to MoveDir returns, Handle is restored by taking the first number off the beginning of the rArray string. Since each number is separated by a space, the InStr function can be used to return exactly the number of digits in Handle. Once Handle is restored, that number is stripped from rArray using the SUBSTR and InStr functions. The use of rArray allows any number of recursive calls to MoveDir.

TrashCan demonstrates only one of the many new programs that can be built using WCL2 and WINCMD 1.3. Enjoy WCL2 and the new functions of WINCMD 1.3. I already find them indispensable in my WINCMD programs. □

DOUGLAS BOLING IS A CONTRIBUTING EDITOR OF *PC MAGAZINE*.

GUIDE TO OUR UTILITIES & HOW TO GET THEM

WCL2

PURPOSE: WCL2—WINCMD Library 2—is a second add-on library for WINCMD, *PC Magazine*'s batch-language utility for Windows. WCL2 can be used in conjunction with WCLIB, the first add-on library. WCL2 requires Version 1.3 of WINCMD.

SETUP: To upgrade to the new version of WINCMD, simply copy the new WINCMD.EXE over the old one. To install WCL2, copy the file WCL2.WCL into the same directory.

REMARKS: WCL2 contains 21 new WINCMD functions in six different groups. Four new String functions—Val, Chr, InStr, and Reverse—let you convert a character to its ASCII code and back again, locate substrings within a string, and reverse the order of a string. The six filename functions—FullPath, GetFileDrive, GetFileDir, GetFilePath, GetFileName, and GetFileExt—return the full pathname of a file or any component of the filename. You can obtain the device, path, filename, or file extension of a file.

The two file-processing functions—FileOpenBox and FileSaveBox—let you access the standard Windows dialog box for opening and saving files.

The two keyboard-monitoring functions let you detect whether a key is being pressed and whether it is in a shifted state.

The three Window functions—SetWindowText, ShowWindow, and IsRunning—let you set the title text of a window and let you make a window visible or invisible. The IsRunning function lets you detect whether a specified program is loaded in memory.

The GetDate and GetTime functions return the system date and time in the formats *mm/dd/yy* and *hh:mm:ss*. The GetTime function uses a 24-hour clock.

The .INI file functions—ReadINIData and WriteINIData—let you read and write to .INI files from your WINCMD programs, locating the appropriate sections and keys.

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PC Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

■ HARDWARE

Negotiating a Merger

❓My computer's 60MB hard disk has two partitions. Now that I've upgraded to DOS 6.2, I'd like to reconfigure the hard disk as a single partition. How can I merge the two partitions into one?

Eric Stoll
Teaneck, New Jersey

▶**PC MAGAZINE:** There's no easy answer to this one. The only way to get a single partition is to use FDISK to delete the existing partitions, and then create a new one. That means you must reformat your hard disk, and before you do so, you'll have to back up all the files on the disk. Further, when it comes time to restore the files to the single-partition drive, you must be extremely careful that there is no duplication of filenames and pathnames. Otherwise, the second of a pair of same-name files will overwrite the first in the restoration process.

While a full backup and restore may seem to be a lot of work for what might appear to be a simple task, there are other benefits to consider. If your hard disk has not been reformatted since the days of the 32MB maximum, it's high time to reformat in any case. And as a dividend, this procedure will leave you with a full backup of all your data—valuable insurance that only a few computer users take the time to acquire.—*Alfred Poor*

Unseemly Displays

❓In our office, we use several DOS programs in which we often need to shift from text mode to graphics mode. On the 15-inch multiscanning monitors that came with our new 486 systems, however, the screen fills with snow and bright lines every time the mode changes. Both the system vendor and the monitor manufacturer say that this annoying screen behavior is normal, but I've used other systems that don't have this problem. What is the real problem here, and what can be done about it?

Donald Harvey
St. Louis, Missouri

▶**PC MAGAZINE:** The problem you describe is indeed endemic to some monitors. Unfortunately, there is no easy fix aside from purchasing a monitor that does not exhibit this behavior. Here's why:

Different display modes require different timings for the signals they are to display on the screen. Even the VGA standard includes multiple resolutions and vertical-scanning frequencies for various text and graphics displays. Moreover, until VESA (Video Electronics Standards Association) established standards for Super VGA images, it almost seemed as if every individual manufacturer picked its own frequencies and timings for displaying different resolutions.

Monitor manufacturers have thus had to come up with circuitry that could analyze the display signal right as it comes across the adapter cable. The circuitry must determine and adjust the monitor not only for the basic horizontal- and vertical-scanning frequencies but also for the finer points of the signal timing, such as the "front porch" and "back porch" timing intervals. Only after the monitor's electronics have made sense of the signal components can it start painting a meaningful image on the screen.

The problem is what to do with the information the monitor receives until it has figured out the timings. Some monitors politely blank the screen, hiding their momentary confusion. A few even use a graceful fade-out and fade-in to mask the transition from one resolution to another. Unfortunately, as you've discovered, many monitors simply let it all hang out and display a scrambled image during the transition period. A related problem causes the size of the image to bounce until the monitor figures out how to display it correctly.

How the monitor handles changing resolutions is part of its basic design, and short of turning the monitor off and on when switching modes, there's nothing you can do to improve matters. If you're in the market to buy new monitors, however, read the reviews carefully for details about how different models handle mode switching or go to a store and try them out for yourself.
—*Alfred Poor*

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Volume Printing on a PC System

❓I'm a computer-services manager whose company is planning to migrate from a minicomputer system to a PC network. We have a huge volume of printouts to produce, however, which in the past has taken two days of continuous printing with a 600-line-per-minute (lpm) printer. I'm concerned that this process will take a week or more when we switch to the PC network. Is my assumption correct?

Kelemework Belai
Addis Ababa, Ethiopia

▶**PC MAGAZINE:** Just as in moving from an English to a metric measurement system, migrating from minicomputers or mainframes to PCs requires learning some new units of measure and translating some familiar units. In the case of printing, you may well find that your PC system can produce your reports even faster than your old minicomputer system.

Assume for the moment that you are printing your reports on 11-inch-long paper and using 6-lines-per-inch vertical spacing. With a half-inch margin at top and bottom, you'll get 60 printed lines per page. A 600-lpm printer running at its rated speed should be able to produce 10 of these pages every minute, or 600 pages per hour.

Laser printers for PCs are fast, reliable, and reasonably priced. When printing text, they can usually print at their rated engine speed. There are a number of 10-page-per-minute laser printers (the equivalent of 600 lpm) on the market for $1,500 or less. Moreover, for a little more money, you can get printers rated at speeds of up to 20 ppm or more, which would theoretically cut the time required for your print runs in half.

Engine speed is only half the story, however. If your current print run takes over two days of nonstop printing—say 50 hours total—then at 600 pages per hour for 50 hours, your 600-lpm printer is churning out a total of 30,000 pages per run. Presumably, you do have to stop occasionally to load paper and change ribbons. A case of paper typically holds ten reams of 500 sheets each, or 5,000 pages, so your print run will require up to six cases of paper.

I don't know of any laser printer on the market that holds six cases of paper at one time, though some have extra-large–capacity paper bins that can hold 1,000 sheets. This still means that the printer will require reloading every hour or 2 during the print run, depending on paper capacity and engine speed.

Further, again depending on specific design, most laser printers require additional toner after printing between 3,000 and 10,000 pages. Thus, you must plan on having to change cartridges or add toner repeatedly during the run.

Nevertheless, while a laser printer will require a bit more attention during long, continuous print runs than your existing 600-lpm printer, you'll likely find that a laser printer will get the same job done in less time.—*Alfred Poor*

Our Advisors

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HOW TO CONTACT US

Do you have a hardware, software, or systems problem you can't solve? Do you have a tip you think other readers could use? Perhaps you'd like a better understanding of how something works. If so, we invite you to tell us about it. Our experts can give you practical solutions to your problems, provide techniques for using your software and hardware more productively, and help you grasp computer concepts and understand the latest technology.

It's easy to contact us. Just send us your submission (use ASCII format for text files) via the medium that's most convenient for you:

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Disk Size Discrepancy

❓I recently purchased two hard disks, one with an advertised capacity of 245 MB and the other with 345 MB. Both FDISK and my computer's BIOS report capacities of only 234 MB and 330 MB, re-

spectively. In my opinion, either I've received two bad disks or the advertising is false. How can I get the extra 25 MB I paid for?

J. L. Cappels
Greenlawn, New York

▶PC MAGAZINE: In all likelihood, the disks are in perfect working order, and you did indeed get what you paid for. The problem is that you are basing your conclusions on mixed measures, which is easy to do with a confusing subject such as hard disk capacities.

Data is stored on a disk (whether floppy or hard) on concentric tracks that are divided into an equal number of sectors. These track and sector divisions do not physically exist on the disk's surface, however; their positions are marked by the presence of specific data recorded on the magnetic medium. This data is placed on the disk during the low-level format process.

You must then format the disk with an operating system—typically DOS for PC-compatibles. This high-level format sets aside portions of the disk to hold information about the disk's structure and where your data is stored on the disk (this is referred to as DOS's file allocation table, or FAT). The space used for formatting information is not available to your applications for data storage, and most utilities report only the space left for storing data.

Vendors typically rate their hard disks in terms of unformatted capacity. This does allow them to report the largest possible value for a disk, but it also means that they do not have to account for the formatting consumption of different operating systems. A 5 percent difference between unformatted and DOS-formatted capacities is typical, so it would appear that your disks' capacities are as advertised; you are simply comparing the advertised unformatted capacity with the formatted capacity.

To avoid this disappointment in the future, you would do well to assume that the claimed specifications are for unformatted capacities unless they specifically indicate otherwise.—*Alfred Poor*

■ **OPERATING ENVIRONMENTS**

Eliminating Duplicate DLLs

❓While running a utility to identify duplicate files on my hard disk, I noticed that many of my applications use the same dynamic link libraries (DLLs) and that many of the DLLs are located in more than one directory. For example, duplicate copies (same file size and date) of DBNMP3.DLL, ORA6-WIN.DLL, and W3DBLIB.DLL are located in both my EXCEL and my APPROACH directories. I also noticed that other files, such as 8014808S.DRV, OEMSETUP.INF, and TURBOWIN .DLL, appear in both my WINDOWS\DIAMOND and my STL \WIN31 directories.

Can I put one copy of the DLLs in my WINDOWS\SYSTEM directory (assuming, of course, it's on my path) and eliminate these duplicate files? And how do I find out the correct directory for the

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CIRCLE 300 ON READER SERVICE CARD

.DRV, .INF, and .DLL files that my Diamond Stealth video card uses?

Barton Gardner
Dayton, Ohio

▶**PC MAGAZINE:** You should be able to replace multiple copies of the same DLL scattered around your disk with a single copy in the WINDOWS\SYSTEM directory. Before doing anything, though, use the DOS commands COMP or FC to compare the files and make sure they're identical. If they are, make a note of the directories the files are in and move a single copy to WINDOWS\SYSTEM.

Why make a note? Because it's possible that a Windows program might require a DLL to reside in a particular directory. That's not exemplary behavior on the program's part, but it does happen from time to time. If you find a program complaining that it can't find a DLL after you perform this consolidation, check your notes and return a copy to the appropriate directory.

As for the video-driver files, that may be a different story. Usually the video driver in use would reside in the SYSTEM directory, not in either of the directories you mentioned. The duplicate driver files you're seeing were probably loaded on the hard disk by the video card's software installation but never actually used under Windows. Try deleting one of each pair of identical files, again making a note of what you did. Now restart Windows. If Windows loads and runs successfully, you've saved a good chunk of disk space.—*Neil J. Rubenking*

■ **WORD PROCESSING**

Automatic Headers in WP 5.1 and 6.0 for DOS

TIP If you type many multipage letters, creating the header for pages two and later can become quite tedious. The WordPerfect 5.1 macro shown in Figure 1 generates a three-line header consisting of the first line of an address, the current date, and the page number. To use it, all you have to do is place the cursor on the first line of the inside address and start the macro.

Deborah Carr
Jupiter, Florida

```
{DISPLAY OFF}
{Home}{Home}{Left}
{Block}{End}{Move}bc
{Format}phap
{Format}ljr{Enter}{Enter}
{Enter}{End}{Enter}
{Date/Outline}t{Enter}
Page•{^B}{Exit}{Exit}
```

Figure 1: **This WordPerfect 5.1 macro automatically creates a three-line header, using the line the cursor is on for the first line of the header, the date for the second line, and the page number for the third line.**

```
DISPLAY(Off!)
PosLineBeg
BlockOn(CharMode!)
PosLineEnd
CopyAndPaste
HeaderA(Create!;AllPages!)
Justification(Right!)
MoveModeEnd
PosLineEnd
HardReturn
DateText
HardReturn
Type("Page ")
PageNumberDisplayFormat
SubstructureExit
Suppress(HeaderA!)
```

Figure 2: **This macro is the WordPerfect 6.0 equivalent of the macro in Figure 1.**

▶**PC MAGAZINE:** Given that the whole point of a header feature is to automate text entry on multiple pages, there's something intriguing about a macro that automates the creation of the header itself.

Since Ms. Carr's macro generates the first line of the header by simply copying the line currently containing the cursor, and then works through the WordPerfect menus to add the date and the page number, you can create the entire macro by recording it. You can, of course, change the formatting if you like. One touch I've added, for example, is right justification.

Note that if you omit the first five commands,

```
{Home}{Home}{Left}{Block}{End}
```

you can define the first header line manually by highlighting all or part of a line before starting the macro. The macro will then use whatever text you've highlighted. You may find this approach useful for a wider range of documents than just correspondence.

As always with WordPerfect 5.1, if you create this macro in the macro-editing screen, you create the commands in brackets by typing Ctrl-V followed by the keystroke that gives the command—Alt-F4 for {Block}, Shift-F8 for {Format}, the Home key for {Home}, and so on.

Figure 2 shows the equivalent macro for WordPerfect 6.0. The only difference in the logic for this version is the addition of the command to suppress the header on the first page.—*M. David Stone*

■ **SPREADSHEETS**

Distant Dating

TIP I recently discovered that Quattro Pro for DOS and Quattro Pro for Windows both allow a much wider range of date values than do Microsoft Excel and Lotus 1-2-3. Excel's date values range from January 1, 1900, through December 31, 2078. 1-2-3's go from January 1, 1900, through December 31, 2099. Quattro Pro for DOS, however, can handle dates from March 1, 1800, to December 31, 2099. And Quattro Pro for Windows reaches both further back and further forward, allowing dates from January 1, 1600, to December 31, 3199! These unusual capabilities appear to be undocumented.

When using the @DATE function in Quattro Pro for Windows to generate a date prior to January 1, 1900, you must use a negative number for the function's first argument. To generate the date December 25, 1850, for example, you'd use the formula

```
@DATE(-50,12,25)
```

The result would be -17902, the serial-date value for Christmas Day, 1850. You could then apply one of Quattro Pro for Windows' date formats to the cell to see a date instead of a serial-date value.

In Quattro Pro for DOS, the @DATE function doesn't accept negative arguments, so you have to enter the serial date directly in the cell.

Shane Devenshire
Walnut Creek, California

▶**PC MAGAZINE:** Actually, the date ranges *are* documented in both versions of Quattro Pro. In Quattro Pro for DOS, you'll find the information on page 27 of the *@Functions and Macros* manual. In Quattro Pro for Windows, you'll find it in the

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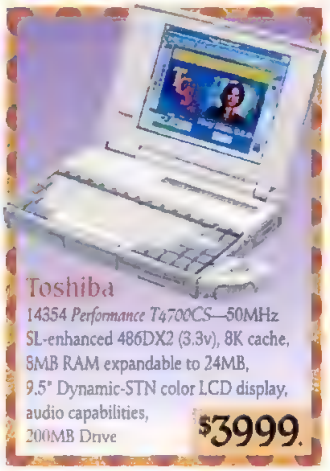

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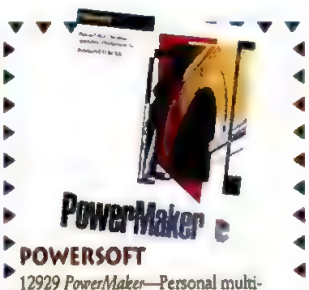

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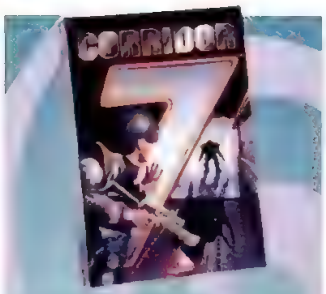

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@DATE topic of the help file. (Alternatively, you can get printed information by asking Borland to ship to you—for a nominal charge—its *Building Spreadsheet Applications* manual.)

In either program, however, the easiest way to generate pre-1900 dates is with the @DATEVALUE function. For example, to get December 25, 1850, into a cell, you'd use the formula

```
@DATEVALUE("12/25/1850")
```

You may also find @DATEVALUE is the easiest way to generate dates in the 21st century and beyond. With @DATE, in order to get January 1, 2010, you'd have to type

```
@DATE(110,1,1)
```

Using 2010 as the year argument will result in an ERR value. A simpler formulation, in my opinion, is

```
@DATEVALUE("1/1/2010")
```

Note, however, that if you adopt the @DATEVALUE approach, you must be sure to use slashes rather than commas to separate the components in your date.
—*Craig Stinson*

■ GRAPHICS

Small Files, Big Problems

❓I've created several presentation graphics files with CorelDRAW, but the files just won't print. The actual file sizes are small—only 23K in one case and 1.1MB in another—and my HP DeskJet 1200C printer has 2MB of RAM. Yet when I try to print the files, I get an message that there's not enough memory.

Hewlett-Packard's technical support told me that "a typical file is really larger than the DOS file size." Does this mean that although I have 2MB of RAM in the printer and both files are well below that limit, I must buy still more memory?

Gary Agron
Leavenworth, Kansas

▶**PC MAGAZINE:** By examining the CorelDRAW files directly (and with some help from CorelDRAW's technical-support staff), I was able to pinpoint the problem.

Both files used fonts (USALight and Aardvaark) that ship with CorelDRAW. Since neither of these fonts are resident in your printer, the program must send all of the words in your documents to the printer not as text but as a series of curves. Normally, this would not cause a printing problem, but your situation is complicated by two facts: The text is formatted with a very thick outline (2 points, or 0.028 inches), and the printer is not a PostScript printer.

The PostScript page-description language can easily *stroke* (the technical term for drawing or rendering a vector outline) a complex curve, such as the letterforms in your document, with a 2-point line. Non-PostScript printers, such as your HP DeskJet 1200C in PCL mode, however, rely on the Windows GDI (Graphics Device Interface) for their printing instructions, and the Windows GDI cannot stroke complex curves with a thick line. As a result, in order to recreate the line, CorelDRAW must convert the curves into a series of polygons, each one of which is only 2 points wide. Even though the PostScript and PCL printouts look the same on paper, they require widely different amounts of memory. For example, the same drawing that requires 23K of disk space grows to 49K when printed to a black and white PostScript device and to more than 500K when printed through the Windows GDI to a black and white PCL printer. The number of bytes the printer must hold is larger still when printing on a color printer, such as the DeskJet 1200C, because the printer must then deal with four "pages"—one each for cyan, magenta, yellow, and black.

Given these constraints, the simplest solution is for you to select each text object in your drawings and remove the outline. To do so, highlight the text with the Text tool, open the Outline tool, and choose the Null option (the box with the X through it). To double-check that the change has been made, select the text object using the Pick tool. The status bar in the upper-right-hand corner of the screen should read, "Fill: Black, Outline: None".

Quite apart from memory limitations, there is also an aesthetic reason for removing the heavy outline from the text. While CorelDRAW allows you to assign an outline to a font for artistic purposes (as in logo design), the outline attribute should never be used for straight body copy. The thick line obscures the serifs (the thin curves that are part of many fonts) and the counters (the holes in letters such as O and P), making the text difficult to read. If you want a bolder look for your text, simply choose a typeface that has a boldface attribute, which you can access through the Text roll-up palette.

If you still find your computer's memory limited when printing the files, you can replace the CorelDRAW fonts with one that is resident in your printer. The HP DeskJet 1200C ships with 45 resident fonts, 10 of which are TrueType fonts. By choosing a TrueType font, such as Arial or Times New Roman, you accomplish two things. First, you can use the boldfaced variant of the font for a heavier look without sacrificing legibility. Second, when you print the file, CorelDRAW can send most of the drawing as text rather than as curves—a much more memory-efficient operation.

Finally, I noted that the larger of your two files includes three clip-art images. Remember that each object in a vector-drawing file uses up printer memory. At first glance, it appears that by adding three clip-art images to a file, you've added three objects. Closer inspection, however, reveals that each image is itself a collection of smaller objects: The clip-art images are structured as groups within groups. When ungrouped, the smallest of the clip-art pictures is composed of 197 objects. The more complex pictures contained 725 and 1,839 objects.

Sad to say, the only way to simplify these pictures for a PCL printer is to edit the drawings manually. Once a clip-art picture is ungrouped, you can remove superfluous details by deleting parts of the drawing. Alternatively, you can select similar elements (for example, those that share the same line weight and color) and combine them using the Combine command (not the Group command) in order to reduce the number of objects that must reside in memory.

Uncovering the mystery of these two drawings doesn't ensure you against future memory problems: You may still need to buy more printer memory. Hewlett-Packard has a memory guide

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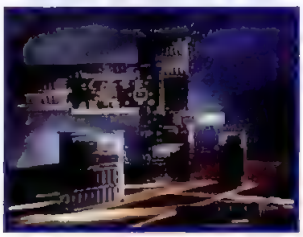

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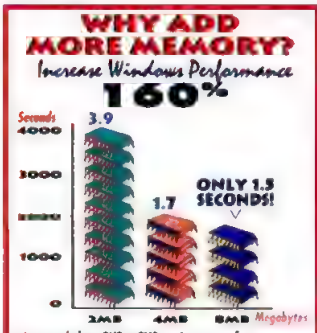

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CIRCLE 014 ON READER SERVICE CARD

with sample images that illustrate the types of images that will print with only 2MB of printer memory versus those that require 4MB of printer memory. You can contact HP's customer-information department at 800-752-0900, or you can call the Personal Peripheral Assistance line at 208-323-2551 for more information. —*Luisa Simone*

NETWORKING

Choosing a Peer-To-Peer Network

❓My organization is planning to install peer-to-peer networking software soon, and I've narrowed the field to two choices: Artisoft's LANtastic and Microsoft Windows for Workgroups. I need some advice on which will best serve our needs.

We already have an Ethernet LAN that runs DECnet and connects a VAX 6510, 3 VAXstation 3100s, and about 20 DECserver 200s. We also bridge to a LAN at our remote site, where there are 2 more VAXstations and 15 DECservers. Finally, we bridge to our home office, which has an extensive network with other VAXs, mainframes, and PCs. Some of the groups we interact with most frequently at the home office are running Windows for Workgroups. We want to tie our 15 or so PCs to this network, not only to have peer-to-peer capability but also to interact with the Digital equipment.

What sort of black magic is needed to make LANtastic or Windows for Workgroups coexist with Digital's Pathworks? Several people need the VAXs' file services and access to the SETHOST command. Can LANtastic cooperate with Windows for Workgroups? Will we be able to send e-mail to the home office and gain access to their assets?

Finally, how well will our existing Windows for Workgroups systems interact with other WfWGs installations? Am I limited to operating within my workgroup, or can I "see" other workgroups?

Michael Hillis
Rio Grande, Puerto Rico

▶**PC MAGAZINE:** To do everything you need to do under LANtastic would be tricky, but it's relatively simple under Windows for Workgroups. Digital's Pathworks and Windows for Workgroups share the same ancestry in Microsoft LAN Manager. While Digital makes a variety of protocol stacks for Pathworks, Pathworks and Windows for Workgroups have at least SMB/NetBEUI and TCP/IP in common.

LANtastic, Version 5.0, can load over NDIS (Network Driver Interface Specification) and if you use Windows for Workgroups, you can have multiple protocol stacks loaded at the same time (this isn't possible under standard Windows 3.1). But this wouldn't gain you anything except interoperability with LANtastic subnetworks.—*Frank Derfler, Jr.*

Wiring 10BaseT

❓I've ordered LANtastic, Version 5.0, for DOS, NodeRunner 2000/T cards, and an external hub. I plan to tackle my own wiring, but I keep getting conflicting directions and advice from the "experts." Could you please clarify:

- Of the wires found in an RJ-45 connector, does 10BaseT use four twisted-pairs (eight wires), three twisted-pairs (six wires), or two twisted-pairs (four wires)? If fewer than eight wires are used, is there any advantage to installing eight wires in the wall? The cost difference isn't great, but why do it if there's no point?
- What is the pin-to-pin wiring scheme from the computer with the card in it to the hub? I've gotten diagrams from different sources that specify cross-wiring the "patch" cables between the computer and the RJ-45 wall outlet as well as between the wall outlet and the hub, and I've also gotten diagrams that indicate cross-wiring *and* straight pin-to-pin wiring from the wall outlet to the computer and from the wall outlet to the hub. In one case, I get three cross-wired segments, which result in a net crossing of the pins. In the other case, with two cross-wired segments and one straight, the result is also a net cross-wired connection. Help!

Leandro Llambi
New York, New York

▶**PC MAGAZINE:** There are standards—and then there are vendors' implementations of the standards. Fortunately, Artisoft conforms to the common implementation of the 10BaseT wiring scheme.

10BaseT uses only two pairs of wires. That's all you need, but equipping your wall jacks with the full capacity of eight pairs is a smart move for the future. In the meantime, however, don't use the spare pairs for anything else, such as telephone systems.

The 10BaseT standard uses pins 1 and 2 for the first pair and pins 3 and 6 for the second pair. There is never any need for transposed pairs or cross-wiring in 10BaseT-standard data systems. In fact, you should take care to make sure that the connections are straight through all the way; otherwise, you'll lose the effectiveness of the electrical shielding provided by the twisting of the wires in each pair.

There are eight commonly used wire sequences used in the United States for wiring an RJ-45 jack. Of these, the Preferred Commercial Building Cabling Specification of the Electronic Industries Association (known in the trade, thankfully, simply as the EIA standard), AT&T 258A, AT&T 356A, and the 10BaseT standards are now the most often used. These standards are all very similar, and you won't run into problems if you follow any one of them. There is an older standard Universal Service Order Code (USOC), however, that was once the most popular wiring sequence. The USOC sequence is not compatible with 10BaseT. You can quickly identify a USOC sequence because the pairs work their way in to the center (1-8, 2-7, and so on) instead of using the 1-2 sequence of 10BaseT.

The best advice I can give you is to invest in a good RJ-45 plug presser. This device aligns the plug and applies the correct pressure to seal the contacts. It's very difficult to do a good wiring job with a poor tool. Furthermore, make sure that you buy and use the proper RJ-45 plugs for the specific wiring segments. You'll need plugs for solid wire on the main runs and plugs for the stranded wire on the jumper cables and on the cables going between the wall and the computer. Using the incorrect type of plug practically guarantees intermittent operation as the system ages.

Finally, remember to keep the twists in the wires to retain as much of the shielding capability as possible. It's tempting to untwist the wires in order to make a neat connection, but don't do it!
—*Frank Derfler, Jr.*

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[illegible]	258	[illegible]	688	738	848	988	1,028	1,108
[illegible]	408	[illegible]	848	888	998	1,128	1,178	1,258
[illegible]	388	[illegible]	808	848	858	1,098	1,138	1,218
[illegible]	288	[illegible]	728	768	878	1,018	1,058	1,138
[illegible]	278	[illegible]	718	758	868	1,008	1,048	1,128
[illegible]	258	[illegible]	698	738	848	988	1,028	1,108
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[illegible]	158	[illegible]	588	638	748	888	928	1,008
[illegible]	578	[illegible]	1,018	1,058	1,168	1,308	1,348	1,428
[illegible]	458	[illegible]	898	938	1,048	1,188	1,228	1,308
[illegible]	388	[illegible]	838	878	988	1,128	1,168	1,248
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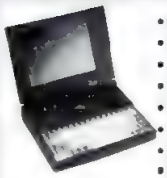

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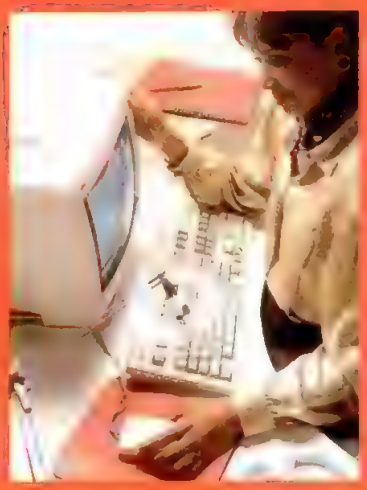

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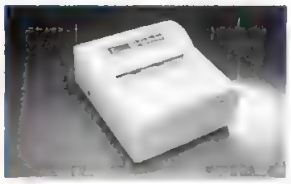

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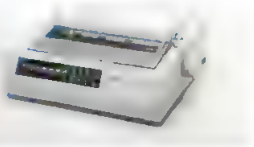

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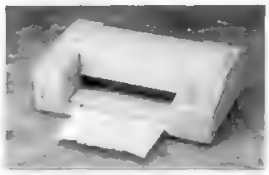

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- 2 MG Ram

JX-9660 PS - $1219.00

- 8 PPM
- 600 dpi
- Postscript
- PCL-5

PC-8650
Active-Matrix Color TFT LCD Notebook Computer

Of the 46 486-based portables tested, Sharp's PC-8650 was awarded Bytes ***"Best Overall Color Notebook"*** and ***"Best Value Color Notebook for Under $4000.00"***

$2679.00

- SL-33 mhz 486 DX Processor
- Dazzling 8.4" Active Matrix Color with 256 colors
- 200 MB Fast Access HDD
- PCMCI 2.0 Slot
- 4 MB Ram

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1MB/4MB Simms .... $49/$159
Compaq Memory ..... CALL
Epson Action 2 MG $139
Cyrix SRx2-20/40 ..... $219
Cyrix DRx2-20/40 ..... $249
Cyrix DRx2-25/50 ..... $289
Cyrix DRx2-33/66 329
HP 4MG Upgrade $159
Intel 80387 SX $75
Intel 80387 DX $85
OKI Laser 2MB $125

★★★Double Time★★★

Intel Ov.Drv.Dx2-25/33 275/ 379
Intel Ov.Drv.SX-20/25 . 279/279
Kingston SX/Now 386-25 . $169
Kingston SX/Now 386-33 . $199
Kingston 486 Now-25 MHz $389

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450	$185	Smt.600	$335
600	$259	Smt.900	$529
900	$369	SM-1250	$679

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BC400/500 Lan ..... $139/$185
BC600/750 ..... $229/$275
Omni 500/600 ..... $239/$275
Omni 750/1250 Lan .. $369/$545

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Netware 3.12 50 User ... $2349
Netware 3.12 100 User .. $3349
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Netware 4.0 25 User ... **$2299**
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Node 2000C 12-Pack.... $1859
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Node Runner SI 5-Pack .. $425
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NE2000/5-Pack ..... $89/$369
SMC Hub 8 Port T/P $319
SMC TP 12 node Conc... $579
SMC+16-6 Pack..... $579
SMC Ethercard +/+16 $89/$115
3 Com EtherLink II 16.... $155
3 Com Etherlink III..... $109
Etherlink III 5 Pack $499
Intel Ether 16 ..... $89
Intel Ether 16-5 Pack..... $419
Intel Ether Flash 5-Pack .. $479
Intel Ether 16-20 Pack... $1599
Intel Eth.Cmbo/5-Pk $115/$539
Intel Netport II..... $359
Intel Token 16/4 ..... $339
Thomas Conrad 5143 Coax $119
TC 5143 Coax 6-Pack $649
TC 5143-10 BT $85
TC 5143-10 BT 6 BK $479
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Laserjet IVL w/Toner..... $675
Laserjet IVML/w/Toner .. $1039
Laserjet IVM w/Toner ... $1949
Laserjet IV SI w/Toner .. $2989
Laserjet IV SI MX **$4389**
HP IV Toner $99
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Jet Direct 2371B $429
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MicroWriter PS65 ..... $935
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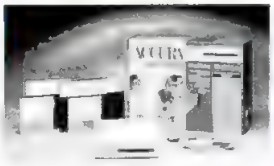

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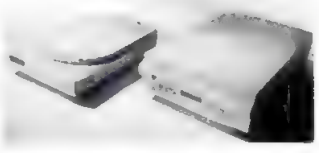

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At MidWest Micro, we always go out of our way for you. We even give you the option of custom configuring a desktop system in one of five sleek case designs (slimline, desktop, mini-tower, middle-tower and full-tower). We'll install fax modems, more RAM, a larger hard drive and more.

Computer Shopper Best Buy of 1993

PC Computing ★★★★★

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3 YEAR

The Real 3 Year Warranty

THE MIDWEST TIMES

THE MIDWEST TIMES

WINNER

MidWest Micro Wins 14th Best Buy

FRONT PAGE NEWS

MidWest Micro tops the news with the Real Three Year Warranty that covers the monitor, hard drive and all internal components – but we don't want to offset all the other services our customers enjoy, like a **30-Day Money Back Guarantee, Immediate Parts Replacement Policy, Lifetime Toll-Free Technical Support and an On-Line Bulletin Board Service**. No matter how the other companies word it, they just don't deliver service and support like this.

Great products, a well-informed sales team and unbeatable prices — it's no wonder MidWest Micro has earned 14 Computer Shopper Best Buy Awards (chosen by Shopper readers) and PC Computing's Five-Star Rating for outstanding service and support. (Check out the article in *The MidWest Times!*) MidWest Micro has been on a winning streak since 1989, and we don't plan on slowing down anytime soon. We're not the only ones winning, though. With affordable technology and friendly service, when you buy from MidWest Micro, you win, too.

MidWest Micro

1-800-682-7256

News Never Traveled So Fast!

"Did you say clock-tripling speeds?"
"I heard the Three-Year Warranty is for real!"
"Martha told me that buying an Elite System was the smartest thing she's ever done."
"Well, Albert and I just ordered an Elite for our grandson."

What's All The Gossip About?

Did you hear about Elite PCI and Pentium™ Systems from MidWest Micro? It's certainly no rumor that Intel's® Pentium processor operates twice as fast as a DX2-66 processor. Plus, superscalar architecture lets it execute two instructions at the same time, dramatically speeding up operation. For such high performance, the price of Elite Systems is very trim.

Psssst...Pass It On

Superior compatibility, automatic configuration and high-speed data handling are making PCI (Peripheral Component Interconnect) Local Bus the talk of the town. Since these systems are self-configuring, adding network cards, video cards and other peripherals has never been easier. (Just ask Martha!)

intel inside pentium PROCESSOR

Seagate

Microsoft WINDOWS FOR WORKGROUPS

Another highlight of PCI Technology is great video performance. It gives you up to 16.7 million colors (that won't wash out after you shampoo) and 1280 x 1024 resolution. And with refresh rates up to 90 Hz, screens redraw faster than you can say split ends!

What Else Is New?

What's new? Elite's new line of Pentium Systems travel at an amazing 90 MHz processing speed, one of the fastest speeds available. Known as P5-90s, these Elites also run cooler and draw significantly less power. If you want to make some permanent waves, order an Elite P5-90 Pentium System from MidWest Micro.

Wait, There's More...

The curling iron isn't all that's hot – so are Elite DX4 VESA Systems! We're talking processing speeds up to 75 and 100 MHz! News hasn't traveled this fast since the grapevine was invented! Plus, with a powerful VESA Local Bus, you get increased throughput and high-speed video.

MidWest Micro's Intel-based Systems give you more than high speed and excellent performance. They also come with large hard drives and MS-DOS 6.2® and WFW™ 3.11 installed. Some configurations even include a double speed multimedia CD-ROM drive and an internal send and receive fax modem! Call the company that everybody's talking about – call MidWest Micro today.

Pentium technology is a lot more than just small talk. It can execute two instructions at once, produce processing speeds up to 90 MHz and make everyday applications run even better. Pentium processors also provide the power needed for new multimedia applications and desktop video conferencing.

And if clock-tripling VESA performance dominates your conversations, you need an Elite DX4 VESA System. With a powerful VESA Local Bus, fast processing speed and double-speed CD-ROM drive, this System never makes you wait! If you'd like to talk more about Elite DX4 and Pentium Systems, call one of the friendly sales representatives at MidWest Micro – they love to talk, too!

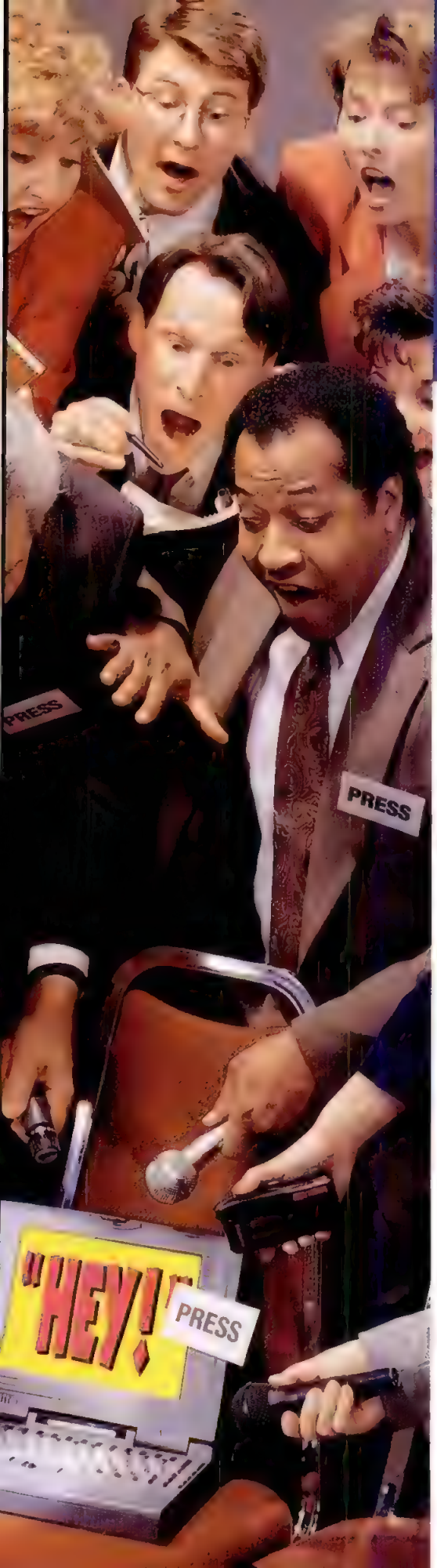
MidWest Micro

1-800-682-7256

AD#G701

"At the top of the heap is the [illegible] Elite which certainly lives up to its name. Its crisp double-scan display is well complemented by its [illegible], high performance chip, intelligent design and quality assembly. When you add to that its impressive battery life and toll free support, at a very reasonable price, the Elite is the class of this field."

Computer Shopper, May 1994



THE ELITE SOUNDBOOK STEALS THE SPOTLIGHT

This Notebook's Got Something To Say

There's simply no better way to get the word out than with the Elite SoundBook from MidWest Micro. Featuring built-in audio capabilities and the processor, hard drive and screen of choice, the Elite SoundBook is always attracting attention (even when it's not supposed to)!

It Can't Keep Quiet!

It's hard for the SoundBook to keep quiet since it comes with a built-in microphone and speaker, external jacks and bundled audio software. The software lets you easily record, compress, store and playback voices, sounds or music. Plus, the Elite features a PCMCIA Type III slot so you can add modems, flash memory, network adapters, and more.

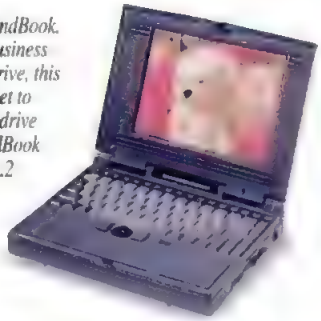
Attracting Attention From Every Angle

The SoundBook also attracts attention with its visual performance. Available in monochrome, dual-scan color and active-matrix color, these screens make presentations look great .

A Keynote Speaker

Even when it's part of the audience, the Elite SoundBook steals the spotlight. Business presentations have never looked or sounded so good! And it comes in a variety of configurations, so you can pick the one that best suits your needs. You can even select a processor with a clock-tripling 100 MHz processing speed! With its long battery life, up to 520 Mb hard drive and local bus video with 1 Mb video DRAM, this lightweight notebook really makes a statement. Invite the Elite SoundBook to your next press conference. It won't just be the topic of discussion—it'll be the main speaker!

The media can't stay away from the Elite SoundBook. With 4 Mb of RAM (expandable to 20 Mb), business audio features and a user replaceable hard drive, this notebook is hot news! And the fact that you get to choose your own processor, screen and hard drive has really got reporters interested. The SoundBook even comes with Lotus Organizer, MS-DOS 6.2 and WFW 3.11 installed. Whether you'd like the color (6.7 lbs.) or monochrome (6.2 lbs.) version, the Elite SoundBook steals the show.



News On a Lighter Note

Ready for more good news? The Elite 486SX-33 SubNote weighs only 3.9 lbs. and comes with a dual-scan color or monochrome screen. With its high-speed RAM and fast processor, this SubNote really beats the press! If you like the lighter side of the news, you're going to love the Elite 486SX-33 SubNote.

MidWest Micro

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AD#G702

PENTIUM PCI SYSTEMS

P5-60 $2299

#007830

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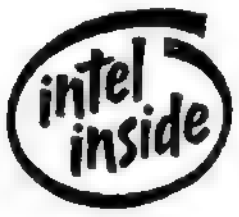
- 340 Mb IDE Hard Drive
- PCI Fast IDE Interface
- PCI Local Bus Graphics
- 3.5" Disk Drive
- 15" SVGA .28 N/I Multi-Scan Color Monitor with Hitachi CRT
- 8-Bay Middle-Tower Case
- 4 ISA, 2 PCI &1 PCI/ISA Slots
- 101-Key Enhanced Keyboard
- MS Mouse
- MS-DOS™ 6.2 and WFW™ 3.11



P5-66 $2699

#007831

- Intel 66 MHz Pentium Processor
- 8 Mb RAM, 256 Kb Cache
- 528 Mb IDE Hard Drive
- PCI Fast IDE Interface
- PCI Local Bus Graphics with 2 Mb
- Double Speed CD-ROM Drive
- Internal 14.4 S/R Fax Modem
- 3.5" Disk Drive
- 15" SVGA .28 N/I Multi-Scan Color Monitor with Hitachi CRT
- 8-Bay Middle-Tower Case
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- 101-Key Enhanced Keyboard
- MS Mouse
- MS-DOS 6.2 and WFW 3.11

P5-66 $2999

#007832

With 1 Gb SCSI HDD & Without 14.4 Internal S/R Fax Modem

P5-66 $3199

#007833

- Intel 66 MHz Pentium Processor
- 16 Mb RAM, 256 Kb Cache
- 528 Mb IDE Hard Drive
- PCI Fast IDE Interface
- PCI Local Bus Graphics with 2 Mb
- Double Speed CD-ROM Drive
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- Pro Audio 16 Sound Card
- Digital Quality, Compact Speakers
- Internal 14.4 S/R Fax Modem
- 3.5" Disk Drive
- 15" SVGA .28 N/I Multi-Scan Color Monitor with Hitachi CRT
- 8-Bay Middle-Tower Case
- 3 ISA, 2 PCI & 1 PCI/ISA Slots
- 101-Key Enhanced Keyboard
- MS Mouse
- MS-DOS 6.2 and WFW 3.11

P5-90 $3499

#007834

- Intel 90 MHz Pentium Processor
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- 528 Mb IDE Hard Drive
- PCI Fast IDE Interface
- PCI Local Bus Graphics with 2 Mb
- Double Speed CD-ROM Drive
- Internal 14.4 S/R Fax Modem
- 3.5" Disk Drive
- 17" SVGA .26 N/I Color Monitor with Hitachi CRT
- 10-Bay Full-Tower Case
- 3 ISA, 2 PCI & 1 PCI/ISA Slots
- 101-Key Enhanced Keyboard
- MS Mouse
- MS-DOS 6.2 and WFW 3.11

P5-90 $3999

#007835

With 1 Gb SCSI HDD

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486SX-33 $1199

#006674

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- 14" SVGA .28 N/I Color Monitor with Hitachi CRT
- 8-Bay Mini-Tower Case
- 5 ISA & 3 VESA/ISA Slots
- 101-Key Enhanced Keyboard
- MS Mouse
- MS-DOS 6.2 and WFW 3.11

486DX-33 $1379

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486DX2-50 $1399

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486DX2-66 $1799

#006677

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- 32-Bit VESA Local Bus Graphics with 1 Mb
- 32-Bit VESA Local Bus IDE
- Double Speed CD-ROM Drive
- 3.5" Disk Drive
- 15" SVGA .28 N/I Multi-Scan Color Monitor with Hitachi CRT
- 8-Bay Mini-Tower Case
- 5 ISA & 3 VESA/ISA Slots
- 101-Key Enhanced Keyboard
- MS Mouse
- MS-DOS 6.2 and WFW 3.11

486DX-33 $1679

#007808

486DX2-50 $1699

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DX4-75 $2399

#007826

- Intel DX4-75 Processor
- 16 Mb RAM, 128 Kb Cache
- 452 Mb IDE Hard Drive
- 32-Bit VESA Local Bus Graphics with 2 Mb
- 32-Bit VESA Local Bus IDE
- Double Speed CD-ROM Drive
- 3.5" Disk Drive
- 15" SVGA .28 N/I Multi-Scan Color Monitor with Hitachi CRT
- 8-Bay Mini-Tower Case
- 5 ISA & 3 VESA/ISA Slots
- 101-Key Enhanced Keyboard
- MS Mouse
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DX4-100 $2499

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DX4-100 PCI $2999

#007829

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- 16 Mb RAM, 128 Kb Cache
- 528 Mb IDE Hard Drive
- PCI Local Bus Graphics with 2 Mb
- Double Speed CD-ROM Drive
- 3.5" Disk Drive
- 17" SVGA .26 N/I Color Monitor with Hitachi CRT
- 8-Bay Middle-Tower Case
- 3 ISA, 2 PCI & 1 PCI/ISA Slots
- 101-Key Enhanced Keyboard
- MS Mouse
- MS-DOS 6.2 and WFW 3.11

SLIMLINE VALUE SYSTEMS

HOME PC 486DX2-50 $1799

#007824

- Intel® 486DX2-50 Processor
- 4 Mb RAM, 128 Kb Cache
- 250 Mb IDE Hard Drive
- 32-Bit Local Bus Graphics with 1 Mb
- 32-Bit Local Bus IDE
- Double Speed CD-ROM Drive
- Microsoft 3 Disk CD-ROM Software Library – Encarta™, Works™ & Money™
- Pro Audio 16 Sound Card
- Digital Quality, Compact Speakers
- 9624 Internal S/R Fax Modem
- 3.5" Disk Drive
- 15" SVGA .28 N/I Multi-Scan Color Monitor with Hitachi CRT
- Slimline Case
- 4 ISA & 1 VESA/ISA Slots
- 101-Key Enhanced Keyboard
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- MS-DOS 6.2 and WFW 3.11

486DX2-66 $1899

#007825

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Every MidWest Micro Elite is backed by:

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14" to 17" $419
15" to 17" $319

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ELITE SoundBook

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- Lotus Organizer™
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- Advanced Power Management with SMM
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- External VGA & Keyboard Port
- MS-DOS 6.2
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- Carrying Case

Monochrome SubNote

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PC MAGAZINE EDITORS' CHOICE

December 7, 1993
Comtrade Professional 66

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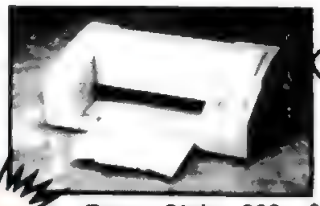

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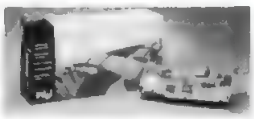

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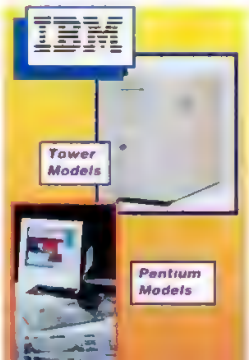

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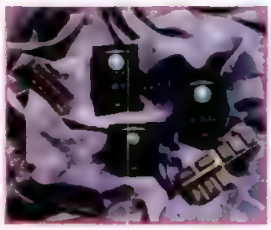

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- Discover preferences by group

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- Learn which promotions work best

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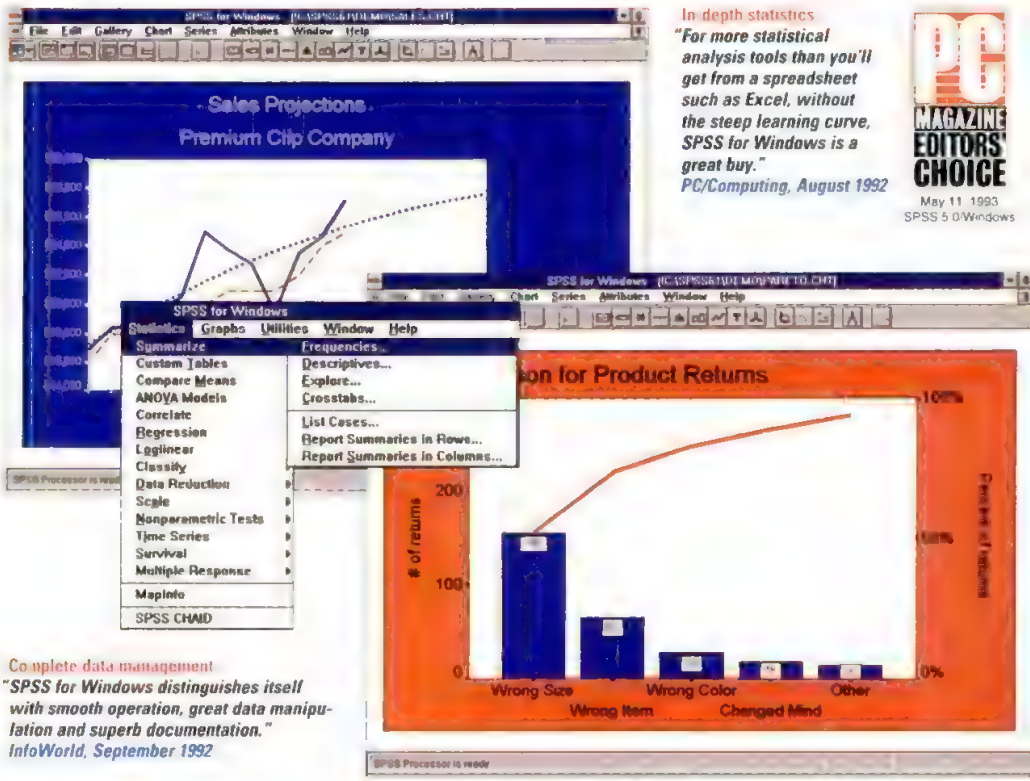

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486SX/33	170MB	$1009
486DX/33	260MB	$1249
486DX/33MT	260MB	$1309
486DX2/66	345MB	$1629
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4/33s 203W	Dual Scan	200MB	$2249

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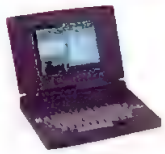

Bravo NB

PowerExec

- ▲ 486SL/33 processor

Model	Screen	Hard drive	Price
Model 203W	Mono	200MB	$2259
Model 203W	Active	200MB	$3899
Model 343W	Active	340MB	$4299

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4/33s Model 273W	8MB	270MB	$1369
4/50s Model 173W	4MB	170MB	$1359
4/50s Model 273W	8MB	270MB	$1589
4/66d Model 273W	8MB	270MB	$1889
4/66d Model 543W	8MB	540MB	$2269
4/100t Model 273W	8MB	270MB	$2339
4/100t Model 543W	8MB	540MB	$2719

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Bravo LC

Bravo MT

Model	Hard Drive	Price*
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4/33 Model 173W	170MB	$1499
4/33 Model 343W	340MB	$1979
4/66d Model 3	Optional	$1659
4/66d Model 173W	170MB	$1929
4/66d Model 343W	340MB	$2399

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- ▲ Resolution Enhancement Technology
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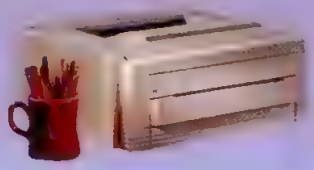

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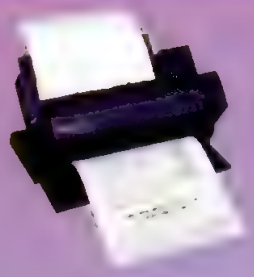

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Screen	Price
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- ▲ 9.5" display
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- ▲ MS-DOS, Windows 3.1
- ▲ Ballpoint mouse with Quickport
- ▲ Enhanced power management

Model	Processor	Screen	Hard Drive	Price
T1910	486SX/33	Monochrome	200MB	$1499*
T1910	486SX/33	Dual scan color	200MB	$2039
T1950	486DX2/40	Monochrome	200MB	$1799
T1950	486DX2/40	Dual scan color	200MB	$2289
T1950	486DX2/40	Active color	200MB	$2979
T1950	486DX2/40	Active color	320MB	$3239

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T4700/T4800

- ▲ 8MB RAM, expandable to 24MB
- ▲ Brilliant 9.5" display with local bus video
- ▲ 2 PCMCIA slots (Type II, Type III)
- ▲ Microsoft Sound System, built-in microphone, audio out port
- ▲ MS-DOS, UltraFont, Indeo video compression software, Windows 3.1 (T4700) Windows for Workgroups 3.11 (T4800)

Model	Processor	Screen	Hard Drive	Price
T4700	486DX2/50	Dual scan color	200MB	$3129*
T4700	486DX2/50	Dual scan color	320MB	$3379
T4700	486DX2/50	Active color	200MB	$4599
T4700	486DX2/50	Active color	320MB	$4949
T4800	486DX4/75	Active color	500MB	$5619

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T4700

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CC4144 14.4/14.4-GOLD	$289.99
XJ1144 14.4/14.4	$269.99
XJ196FM 96/96	$219.99
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Processor	Screen	Hard drive	Price
DX2/40	Active color	120MB	$3819
DX2/40	Active color	250MB	$4229
DX2/50	Monochrome	209MB	$3259*
DX2/50	Active color	209MB	$4499
DX2/50	Active color	340MB	$4919
DX4/75	Active color	340MB	$5229

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- ▲ 8KB cache expandable to 256KB
- ▲ Local bus True Color video
- ▲ Graphics accelerator
- ▲ 3 expansion slots, 3 drive bays
- ▲ MS DOS, Windows 3.1, NEC mouse

Processor	Hard drive	Price
486SX/33	170MB	$1129*
486DX2/50	210MB	$1399
486DX2/66	210MB	$1749

NEC SVGA monitor $319.99

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3V

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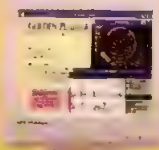
- ▲ 72MHz VESA refresh
- ▲ MPR II, EnergyStar



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- ▲ MS DOS 6.0, Windows 3.1

Processor	RAM	Hard Drive	Price
486SX/33	4MB	200MB	$1099*
486DX2/50	4MB	340MB	$1599
486DX2/66	4MB	340MB	$1829
486DX2/66	4MB	525MB	$1969
486DX4/100	8MB	340MB	$2299
486DX4/100	8MB	525MB	$2469

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- ▲ 209MB hard drive
- ▲ 9.5" display, available with monochrome or dual scan color display
- ▲ MS-DOS 6.0, Windows 3.1, trackball

Screen	Price
Monochrome	$1989
Dual scan Color	$2319

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- ▲ 9.5" mono display
- ▲ 2 TYPE II or 1 Type III PCMCIA slots
- ▲ Untethered intelligent pen
- ▲ MS-DOS 6.0, Windows 3.1, InkWare NoteTaker
- ▲ PenPower for Excel

Processor	RAM	Hard Drive	Price
486SL/25	4MB	120MB	$1229
486SL/25	4MB	250MB	$1319
486SL/33	4MB	250MB	$1399

Lease for $50/mo.

Contura Aero

- ▲ Type II PCMCIA slot
- ▲ Integrated trackball
- ▲ Weighs only 3.5 lbs.(mono), 4.31 lbs. (color)
- ▲ MS-DOS, Windows 3.1

Processor	Display	Hard Drive	Price
486SX25	Mono	87MB	$1329
486SX25	Mono	170MB	$1599
486SX33	Passive Color	170MB	$2079
486SX33	Passive Color	250MB	$2359

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Processor	Hard Drive	Price*
486SX/25	120MB	$889
486SX/25	120MB	$929
486DX/33	212MB	$1399
486DX2/66	212MB	$1789

*monitor priced separately

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- ▲ IBM DOS 6.1, MS Windows 3.1, mouse

Processor	Hard Drive	Price*
486SX/33	170MB	$1219
486DX/33	212MB	$1559
486DX/33	340MB	$1719
486DX2/66	340MB	$2159

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- ▲ 5 drive bays

Processor	Hard Drive	Price*
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Pentium 60MHz	525MB	$4099

*monitor priced separately

IBM Monitors	Price
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14", digital controls, .28mm	$419.99
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- ▲ PCMCIA Type II slot
- ▲ TrackPoint II integrated pointing device
- ▲ IBM DOS, PRODIGY

Screen	Hard Drive	Price
Monochrome	250MB	$1639
Monochrome	250MB	$2029
Passive Color	125MB	$1939
Passive Color	250MB	$2609

ThinkPad® 500 subnotebooks

- ▲ IBM 486SLC2/50 processor
- ▲ 4MB RAM exp. to 12MB
- ▲ 170MB hard drive
- ▲ 7.4" VGA monochrome display
- ▲ Type II PCMCIA slot
- ▲ TrackPoint II integrated pointing device
- ▲ 3.5" external floppy drive
- ▲ NiMH battery, AC adapter
- ▲ Weighs only 3.8 lbs. (w/battery)
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- ▲ Integrated trackball
- ▲ Two Type II or one Type III PCMCIA slot
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- ▲ 3-year warranty

Processor	Screen	Hard Drive
486SX/33	10.4" monochrome	200MB
486DX2/50	10.3" dual scan	200MB
486DX2/50	9.5" active matrix	340MB
486DX2/50	9.5" active matrix	450MB
Intel DX4/75	9.5" active matrix	520MB

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	45NS	60NS	70NS	80NS	100NS
1Megx1	–	7.35	7.25	6.75	5.95
1Megx4	–	35.00	29.00	27.00	–
1Megx4 (Zip Pk)	27.00	25.00	23.00	–	
256 x 4 (Video Zip)	–	15.95	11.95	10.95	
256x4	8.95	7.95	6.95	–	–
256 x1	–	4.00	3.50	3.00	2.75
256 x16VRAM	–	–	39.00	39.00	–
64x4	–	–	–	3.25	–
64x1	–	–	–	–	2.00

INTEL Math Chips

8087	39.00
8087-2	45.00
8087-1	79.00
80287-XL	49.00
80387-16 DX	39.00
80387-20 DX	44.00
80387-DX (Does All)	74.00
80487-SX (Does All)	299.00
Intel SX (Does All)	69.00
Intel SL Mobit	69.00
Intel 16SX	39.00
Intel 20SX	49.00

AMBRA

Ambra Pentium-60	4/8/16 Meg	175.00/339.00/699.00
Ambra S4540SL	4/16 Meg Kit	CALL
Ambra Sprinta 386, Hurdle 386SX, Enterprise 386 Slim	2/8 Meg Kit	CALL
Ambra Sprinta, Hurdle & Enterprise 486	4/16 Meg Kit	CALL
Ambra NC 425SL	2/4/8 Meg	109.00/209.00/449.00
Ambra N Series	4/8/12/16 Meg	189.00/379.00/569.00/629.00
Ambra SN Series	4/16 Meg	189.00/629.00

CYRIX DRx² 386 to 486 Upgrade

Clock Doubler

- Simple chip upgrade solution
- Clock doubling technology
- Compatible with industry standard 386SX CPU socket
- Compatible with DOS, Windows, 3X, OS/2 1.3 and 2.x
- Uses industry standard math chip
- Easy to install—about 15 minutes

The Cyrix upgrade runs at twice the speed of your original 386 microprocessor combined with a 1K on-chip cache you will enjoy a performance boost of 100% and more. Ideal for any DOS, Windows or OS/2 application which requires a large amount of microprocessor horsepower

CX486 DRx2-16/32	269.00
CX486 DRx2-20/40	279.00
CX486 DRx2-25/50	319.00
CX486 DRx2-33/66	359.00
CX486 SRX2 16/32	249.00
CX486 SRX2 20/40	249.00
CX486 SRX2 25/50	279.00

SIMM MODULES (Add $5.00 for SIPP)

	40NS	50NS	60NS	70NS	80NS	100NS
1Meg x 9 (3 chip)	54.00	52.00	45.00	44.00	42.00	–
1Meg x 9 (9 chip)	54.00	–	48.00	47.00	46.00	40.00
4Meg x 9	–	–	179.00	177.00	166.00	–
16Meg x 9 (9 chip)	–	–	–	719.00	–	–

72 PIN SIMMS (EISA)

1 x 32 4Meg	–	–	189.00	169.00	169.00	–
2 x 32 8Meg	–	–	349.00	329.00	329.00	–
4 x 32 16Meg	–	–	659.00	639.00	639.00	–
256 x 36 1Meg	–	–	–	–	59.00	–
512 x 36 2Meg	–	–	–	94.00	89.00	–
1 x 36 4Meg	–	–	189.00	179.00	168.00	–
2 x 36 8Meg	–	–	379.00	345.00	340.00	–
4 x 36 16Meg	–	–	719.00	689.00	689.00	–
8 x 36 32Meg	–	–	1539.00	1499.00	1499.00	–
16 x 36 64Meg	–	–	3629.00	3509.00	–	–

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AST MEMORY

MODEL	AMT. UPGRADED	AST PART #	PRICE
Bravo LC 4/25S, 4/33, 4/33S, 4/50d, 4/66d	2Meg	500987-001 (72 pin)	CALL
	4Meg	500987-002	179.00
	8Meg	500987-003	419.00
	16Meg	500987-004	819.00
	32Meg	500987-005	1399.00
Premium 486/25, 25S, 33, 33S			
Premium 386/33TE, 486/25TE, 33TE			
Prem. Serv., Prem II 386SX/20, 25	8Meg	500780-001 (64 pin)	399.00
Prem. II 386/25, 386/33, 486/25, 486SX/20			
Premium 386/33T, Prem 386SX/16			
Prem. II 386SX/20, 25		500780-004	189.00
Premium 386/25, 33, 386/33T, 386SX/16,		500780-003	99.00
Prem. II 386SX/20,25		500780-001	59.00
Premia 4/33d, 4/33, 4/50D, 4/66D	8Meg	501159-002	379.00
Premia	16Meg	501159-003	799.00
Premia	32Meg	501159-004	1499.00
Premia	64Meg	501159-005	3111.00
AST Cupid 8d	0-64Meg	500916-001	179.00

ZENITH MEMORY MODULES

MODEL	AMT. UPGRADED	AST PART #	PRICE
Z386/33, 25, 20, 33E	1Meg	ZA3800ME	59.00
Z386/33, 25, 20, 33E, 486/25E	4Meg	ZA3800MK	180.00
Z386SX	2Meg	Z 805-1 modules	119.00

MAGNAVOX

386/386SX-16 386SX-20 486SX 20 & 386-33 all are 72PIN SIMM

1MEG – 59.00 4MEG – 180.00 8MEG – 349.00 16MEG – 659.00

MEMORY BOARDS

IBM Compatibles & PS/2

USES SIMMS

BOCA AT PLUS

16 BIT MEMORY BD. FOR 286, 386 AT • DK-8Meg Bd 4.0 LIM Compat • New 5 Yr Warr Convent, Expnd & Extnd Memory • Supports DOS OS/2, LIM/EMS & EEMS • Versatile Split Memory Addressing • Operates w/CPU Speeds to 33 MHz • Supports Desqview, Multitask operations • Bd. made by Boca Research, AT plus

0K – $84.00 2Meg – $159.00 4Meg – $239.00 8Meg – $399.00

BOCA XT 8 BIT BUS

• Expanded memory for XT • Lim 4.0 compat. 0-2Meg • Uses 256x1-100

0-K – 99.00 1Meg $189.00 2Meg – $229.00

IBM P/S2 32BIT EXPANSION BD.

0-16Meg Ext.-Expnd. Memory Bd. for P/S2 70, 80, 90 Lim 4.0

0Meg	2Meg	4Meg	8Meg	16Meg
$139.00	$239.00	$319.00	$499.00	$859.00

PS/2 MCA 0-8MEG EXPANSION BD.

0-8Meg Extended and or Expanded Memory for all IBM P/S2 Models 50, 50Z, 60, 55SX, 65SX, 16 Bit, 4.0 LIM Compat.

0K – 119.00 2Meg – 199.00 4Meg – 283.00 8Meg – 449.00

USES 1 X 9 SIMMS BOCA BM MC-30

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• Features IBM® 486 SLC2 Processor Clock Doubling (25/50 or 33/66). 16K of Internal Cache	286 (CPU)	PLCC (Type)	25/50 MHz	279.00
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• Simply Replaces existing 286 Processor' Installs in 15 minutes	286 (CPU)	PLCC (Type)	33/66 MHz	369.00
	286 (CPU)	PGA (Type)	33/66 MHz	369.00

IBM PS/1, PS/2 MEMORY MODULES

IBM PART NO.	WORKS WITH MODEL NO.	PRICE
30F5348 (512K)	30-286	37.00
30F5360 (2Meg)	30-286, 25-286, 50 MOTHER BD.	104.00
6450375 (1Meg)	80-011	79.00
6450379 (2Meg)	80-111, 311-121, 321, 081, 161	84.00
6451080 (4Meg)	80-A21, A-61, 80-A31, 80-111, 80-311	189.00
6450604 (2Meg)	70-061, 061, 121, 50Z, 55SX, 65SX, P-70, 55LS, 65LS, X-Station 120 & 130, 35SX, 35LS, 40SX	89.00
6450808 (2Meg)	70-A21, A-61, 8-21, 8-61, 35SX, 35LS, 40SX, Val Pt. 325T	90.00
78X9955 (128K)	25	35.00
34F2933 (4Meg)	35SX, 40SX, 55SX, 65SX, 55LS, 65LS	175.00
87F9977 (4Meg)	55SX, 55LS, 65SX, 40SX, 35SX, 35LS	175.00
1057035 (512K)	P/S1-285	49.00
92F9935 (2Meg)	P/S1 & P/S1/386SX-2121	109.00
92F9694 (4Meg)	P/S1 & P/S1/386SX, Model-2121	189.00
6450902 (2Meg)	56, 57 57SX,90, 95, P-75, 57SLC Value Point 77 486DX2, 486SX, SVR 85	90.00
6450128 (4Meg)	57SX, 90, 95, P-75, 57SLC, 56, 56SLC, P/S1, 386SX, Mod-2123, 2133, 2155, Val Pt 77, 486CS2, 486SX, SVR85 Value Point 77 486DX2, 486SX, SVR 85	175.00
6450129 (8Meg)	35SX, 40SX	339.00
6450130 (16Meg)	56, 57 57SX, 90, 95, P-75, 57SLC Value Point 77 486DX2, 486SX, SVR 85	339.00

IBM NOTEBOOK & LAPTOP MEMORY

——— (4Meg)	Thinkpad 500	230.00
——— (8Meg)	Thinkpad 500	459.00
79F0096 (2Meg)	LX40, N33SX, PS Note, Thinkpad 710T	103.00
79F1000 (4Meg)	LX40, N33SX, PS Note, Tkpd 350, 350c, 710T, PS Note 425	189.00
79F1001 (8Meg)	LX40, N33SX, PS Note, Thinkpad 710T	369.00
07G1826 (2Meg)	N51 (all)	103.00
07G1827 (4Meg)	N51 (all)	199.00
07G1828 (8Meg)	N51 (all)	419.00
07G1415 (4Meg)	Thinkpad 750, 750c	199.00
07G1416 (8Meg)	Thinkpad 750 750c	389.00
86G0094 (16Meg)	Thinkpad 750 750c	849.00
07G1420 (4Meg)	CL57LSX LpTp Thinkpad 700 700C, 720, 720C	199.00
07G1421 (8Meg)	CL57LSX LpTp Thinkpad 700 700C, 720, 720C	389.00
80G0378 (8Meg)	Thinkpad 350, 350c PS Note 425	359.00
80G0379 (16Meg)	Thinkpad 350, 350c PS Note 425	669.00
92F8804 (2Meg)	N45SL	109.00

COMPAQ MEMORY MODULES

MODEL	AMT. UPGRADED	CMPQ PART #	PRICE
DeskPro 386/33, 386/33L, 486/25, 486/33L, 486/50L, System Pro	2Meg Module	115144-001	139.00
	8Meg Module	116561-001	429.00
	32Meg Module	116568-001	1459.00
DeskPro 386/33L, 486/33L	Exp Bd	116569-001	279.00
DeskPro 386/25, 386/20	1Meg Module	113131-001	79.00
	4Meg Module	113132-001	199.00
DeskPro 386S-16MHz	1Meg Exp Bd	113833-001	149.00
	4Meg Exp Bd	113834-001	279.00
	1Meg Module	113646-001	79.00
	4Meg Module	112534-001	199.00
DeskPro 386/20E	1Meg Exp Bd	113644-001	149.00
DeskPro 386/25E	4Meg Exp Bd	113645-001	279.00
	1Meg Module	113131-001	79.00
	4Meg Module	113132-001	219.00
DeskPro 286N, 386N, 386SX/20, 386/25M, 486/25M, 486SX/8M	1Meg Module	118668-001	89.00
	2Meg Module	118669-001	89.00
	4Meg Module	118690-001	199.00
Port. I Series 486C	8Meg Module	128877-001	389.00
M Series Exp Bd	0-64Meg	129160-001	189.00
DeskPro 386/16	1Meg Kit	108071-001	99.00
	4Meg Kit	108072-001	299.00
	1-2Meg Exp Bd	108069-001	239.00
	4-8Meg Exp Bd	108070-001	437.00
DeskPro 286	512K Kit	113012-001	49.00
DeskPro 5/60, 5/66M, 5/66M (ALL OF THESE MACHINES USE THESE MODULES)	8Meg Kit	149911-001	389.00
Prosignia 5/60	16Meg Kit	149949-001	707.00
Prolant 100 5/60	32Meg Kit	149912-001	1399.00
Prolant 2000 4/30, 5/66	64Meg Kit	149913-001	2700.00
Prolant 4000 4/50, 5/66	128Meg Kit	149914-001	5900.00
Proliness 386 3/25S, 3/25ZS	2Meg	141738-001	109.00
	8Meg	141742-001	338.00
Proliness 486 4/25S, 4/33, 4/50, 4/66, CDS	2Meg	141683-001	95.00
Prosario series	4Meg	141684-001	175.00
	8Meg	141685-001	339.00
Prosignia PC Server, 486/33, 486 DSX/66	8Meg	141685-001	339.00
	16Meg	149320-001	699.00
	32Meg	149147-001	1525.00

COMPAQ LAPTOPS & NOTEBOOKS

LTE 286	2Meg Bd	111081-002	99.00
LTE 286	4Meg Bd	117081-003	179.00
LTE/386S/20	4Meg Module	121125-002	209.00
LTE, LTE/20, 25, 25C	4Meg Module	129769-002	209.00
LTE, LTE/20, 25, 25C	8Meg Module	129769-003	419.00
LTE, LTE/20, 25, 25C	16Meg Module	129769-004	809.00
LTE LITE 4/25C 4/25E, 433C	4Meg Module	142333-002	179.00
LTE LITE 4/25C 4/25E, 433C	8Meg Module	142333-003	349.00
LTE LITE 4/25C 4/25E, 433C	16Meg Module	142333-004	774.00
SLT 286	1Meg Module	110235-001	75.00
SLT 286	4Meg Module	110237-001	249.00
SLT 386	1Meg Module	118301-001	79.00
SLT 386	2Meg Module	118304-001	109.00
SLT 386	4Meg Module	118305-001	219.00
Concerto, LTE Elite	4Meg	144790-001	199.00
	8Meg	144790-002	399.00
	16Meg	144790-003	809.00
Contura 320, 325	2Meg	139497-001	99.00
	4Meg	139498-001	179.00
	8Meg	139499-001	349.00
Contura 4/25, 4/25C, 4/25CX	4Meg	146520-002	179.00
	8Meg	146521-001	339.00
	16Meg	146531-001	759.00
Aero (3.3 volt)	4Meg	190532-001	219.00
	8Meg	190597-001	433.00

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TOSHIBA LAPTOP MEMORY

MODEL	AMT. UPGRADED	MANU. PART #	PRICE
T1000SE, XE, LE	2Meg	PC14-PA8312U	94.00
T2000/T3000SX	2Meg	PC18-PA8317U	94.00
T2000SX, T1000LE	4Meg	PC-PA8314U	189.00
T2000SX, T1000LE	6Meg	PC14-PA8315U	359.00
T2000SXE, T2000SX, T1800, 1850 C	2Meg	PC-PA2000U	94.00
T2000SXE, T2000SX, T1800, 1850 C	4Meg	PC-PA2001U	189.00
T2000SXE, T2000SX, T1800, 1850 C	8Meg	PC-PA2002U	359.00
T4400SX, SXC, T6400, T6600	4Meg	PC-PA2004U	199.00
T4400SX, SXC, T6400, T6600	8Meg	PC-PA2005U	379.00
T4400SX, SXC, T6400, T6600	16Meg	PC-PA2010U	699.00
T4500, T4600, T4700, T5000, T1910, T1950 (3.3)	4Meg	PC-PA2012U	209.00
T4500, T4600, T4700, T5000, T1910, T1950 (3.3)	8Meg	PC-PA2013U	409.00
T4500, T4600, T4700, T5000, T1910, T1950 (3.3)	16Meg	PC-PA2014U	839.00
T3300SL	8Meg	PC-PA2008U	268.00
T3300SL	16Meg	PC-PA2009U	699.00
T3400CT	4Meg	PC-PA2019V	199.00
	8Meg	PC-PA2020V	399.00
	16Meg	PC-PA2021V	819.00
	32Meg		1599.00
T1200XE	2Meg	PC13-PA8306	99.00
T1600	2Meg	PC8-PA8302U	99.00
T3100	2Meg	PC3-PA7135E	139.00
T3100e	2Meg	PC9-PA8340U	109.00
T3100SX	2Meg	PC15-PA8108U	109.00
T3100SX	4Meg	PC15-PA8110U	199.00
T3200	3Meg	PC6-PA7137U	185.00
T3200SX	2Meg	PC12-PA8107U	119.00
T3200SX	4Meg	PC12-PA8909	199.00
T3200SXC	2Meg	PC19-PA8118U	119.00
T3200SXC	4Meg	PC19-PA8319U	199.00
T5100	2Meg	PC7-PA8301U	95.00
T5200/T8500	2Meg	PC10-PA8141U	114.00
T5200/T8500	8Meg	PC10-PA8313U	419.00

NOTEBOOK, LAPTOP MEMORY

MODEL	AMT. UPGRADED	MANU. PART #	PRICE
ACER 700	2Meg, 4Meg, 8Meg		109/209/449
ACER 750	4Meg, 8Meg, 16Meg		199/459/969
Acer Aspire	4Meg	12407980	199.00
AST Bravo & Explorer	4Meg, 16Meg	501255-001, 002	199.00/789.00
AST Notebook Prem Exec 386SX/20/25/25L	4Meg	[illegible]	189.00
AST Power Exec 3/25C, 425EL	4Meg		199.00
AST Power Exec 3/25C, 425EL	16Meg		819.00
AST Power Exec 425SL	4Meg	501166-001	199.00
AST Power Exec 425SL	16Meg	501166-003	819.00
AST Power Exec 4/33SL	4Meg, 16Meg	501318-001, 002	194.00/769.00
AT&T Safari NSX/20	4Meg	FEC 37651	259.00
Bondwell B310 Plus	1Meg	23050-09100	139.00
Bondwell B310V SX	1Meg		109.00
Bondwell B310V SX	4Meg		229.00
Canon Innova 486	2Meg, 4Meg, 8Meg		109/209/449
Canon Notejet 486	4Meg, 8 Meg		219.00/419.00
Chicony Ultra Hyundai 386	4Meg		199.00
Epson NB3	3Meg	A808511	199.00
Everex Tempo LX, JX20, Carrier	2Meg	PCA 00053-0001	139.00
Gateway 2000 Nomad 425 DXL/SXL	4Meg, 16Meg		199.00/1549.00
Gateway 2000 486 Handbook	4Meg, 16Meg		199.00/799.00
Goldstar GN-520 386SX/16	4Meg	S386-4M	249.00
Grid 1530, 1550, 1535	1Meg		49.00
Magnavox Metavis	1Meg, 4Meg	286 386SX	109.00/199.00
NEC Prospeed 286 386SX-16	1Meg	PC2-21	79.00
NEC Prospeed 286 386SX 16	4Meg	PC2-22	199.00
NEC Prospeed 386	2Meg	PC3-21	119.00
NEC Prospeed 386	8Meg	PC3-22	399.00
NEC Prospeed 386SX 20	2Meg	PC43-21	79.00
NEC Prospeed 386SX 20	4Meg	PC43-22	199.00
NEC Ultralite Versa	4 Meg/8Meg	DP410M	183/359.799/988
Packard Bell [illegible] 386	1Meg, 4Meg	286 386SX	109/199
Panasonic CF170, CF270, CF370	1Meg	CF BA165	49.00
Panasonic CF286, 1[illegible]	2Meg, 4Meg		119/199.00
Sanyo 1718 NB	2Meg	MBC NBAME M2	139.00
Sharp 6781, 6881, 6785	2Meg, 4Meg		109.00/199.00
Sharp PC-6220	1Meg	EE 621B	79.00
Tandon PC Brand Datarword	2Meg, 8Meg	NB386X 20	119.00/429.00
TI Travelmate 2000	1Meg	2568034 J001	79.00
TI Travelmate 3000	2Meg	2566996-1	84.00
TI 4000	4Meg, 16Meg		199.00/799.00
Tandy 1510, 2810, 3810	1Meg		49.00
Tandy 2820, 3820, 3830	2Meg, 4Meg		119/199.00
Twinhead Altima Computing 486SX, DX, Tandy 4860	4Meg, 16Meg		199.00/859.00
Ultra 486	2Meg, 4Meg, 6Meg		CALL
Zeos 386SX Notebook (not the + version)	2Meg		109.00
Zenith Master Sport 386SX	2Meg	ZA 300 1	114.00
Zenith Master Sport SL, SLE	2Meg	ZA 4 4	119.00
Zenith Super Sport 286 286E	1Meg	ZA 180-66	99.00
286E SX	2Meg	ZA 180-64	149.00
SX Alpha	1Meg	ZA 180-86	149.00
SX Beta	2Meg	ZA 180-87	149.00
Zenith Note 325L, LC	2Meg, 8Meg	ZA3250-45	129.00/419.00
Zenith [illegible] 425LX, LC, NP	4 8 16Meg		[illegible]

PCMCIA VERSION 2.0

(for Palmtop & Subnotebooks)

MODEL	PRICE	MODEL	PRICE
S RAM Cards 1MEG	159.00	9600/9600 Data/Fax Modems	209.00
S RAM Cards 2MEG	179.00	2400/9600 Data/Fax Modems	139.00
Card Pro (made by Data I/O) Transfers data from PCMCIA card to desktop PC, connects to a parallel port	269.00	Lan Ethernet (10 Base T)	219.00
		Visual Media (CD Rom Tape Dr)	279.00
		Bus Toaster™ (High speed SCSI II)	299.00
		Wavjammer™ (16 bit stereo sound card)	319
14 400/14 400 Data/Fax Modems	239.00	105 Mg Type III Hard Drive	519.00

FLASH MEMORY 2 5Meg–299.00 5 Meg–389.00 10Meg–599.00 20Meg–999.00

"Flash" Memory Cards appear to the host computer as a hard disk drive. In a DOS environment, your system will use the flash card just like an [illegible] hard disk. In a [illegible] environment, your system will [illegible] the flash card as a [illegible] hard disk. [illegible] Flash Memory Cards [illegible]

LASER PRINTER MEMORY UPGRADES

AMOUNT UPGRADED	DK 94	256K	1	2	3	3.5	4	5	6	8	16	32
Canon LBP4, 4Lite, 4plus	–	–	159	219	–	–	–	–	–	–	–	–
Epson 6000 Action Laser	–	–	–	139	–	–	229	–	–	–	–	–
Epson Action Laser II	–	–	89	–	229	–	–	367	–	–	–	–
Epson 8000	–	–	89	–	229	–	–	367	–	–	–	–
Epson 7000, 7500	–	–	229*	–	–	–	259*	–	Call	*IN STOCK		
HP II, 2D	–	–	–	109	–	–	189	–	–	–	–	–
HP 3, 3D, 3P, 2P, 2P+	–	–	–	149	–	–	189	–	–	–	–	–
HP 4, 4M, 4Si, 4SiMX, 4P, 4MP	–	–	–	89	–	–	189	–	–	349	–	–
HP 4L	–	–	59	–	–	–	–	–	–	–	–	–
HP 3Si	–	–	89	–	–	–	189	–	–	349	–	–
HP 4Si	–	–	–	89	–	–	189	–	–	349	–	–
HP Design Jet 600, 650	–	–	–	–	–	–	189	–	–	349	–	–
HP Deskjet 500, 500C, 510, 550	55	–	–	–	–	–	–	–	–	–	–	–
HP Deskjet 1200C, 1200C/P	–	–	–	89	–	–	189	–	–	349	–	–
HP Paintjet XL300	189	–	–	–	–	–	289	–	–	469	837	–
IBM Laser 4019, 4019E	–	–	–	–	–	189	–	–	–	–	–	–
IBM Laser 4029	–	–	–	–	–	–	189	–	–	–	–	–
IBM Laser 4039, 4079	–	–	–	99	–	–	189	–	–	350	–	–
NEC 90 290	–	–	–	139	–	–	–	–	–	–	–	–
NEC 95, 97	–	–	–	99	–	–	–	–	–	–	–	–
Oki 400	–	–	–	89	–	–	–	–	–	–	–	–
Oki 400 E	–	–	135	189	–	–	–	–	–	–	–	–
Oki 830, 840	–	–	–	189	–	–	–	–	–	–	–	–
Packard Bell PB 9500	–	–	–	139	–	–	227	–	–	–	–	–
Packard Bell 9815	–	–	–	189	–	–	299	–	–	–	–	–
Panasonic 4420/4450i	–	–	–	129	–	–	189	–	–	–	–	–
Panasonic 4410/4430	–	–	–	129	–	–	195	–	–	–	–	–
Panasonic 4450	–	–	99	–	–	–	–	–	–	–	–	–
Panasonic 4400/5400	–	–	Call	Call	–	–	–	Call	–	–	–	–
Panasonic 4440, 5410	–	–	Call	Call	–	–	–	Call	–	–	–	–
Sharp 9400, 9460, 9600	–	–	Call	Call	–	–	–	–	–	–	–	–
TI XL/PS17/PS35	–	–	55	–	–	–	–	–	–	–	–	–
TI MicroWriter	–	–	79	159	–	–	–	–	–	–	–	–

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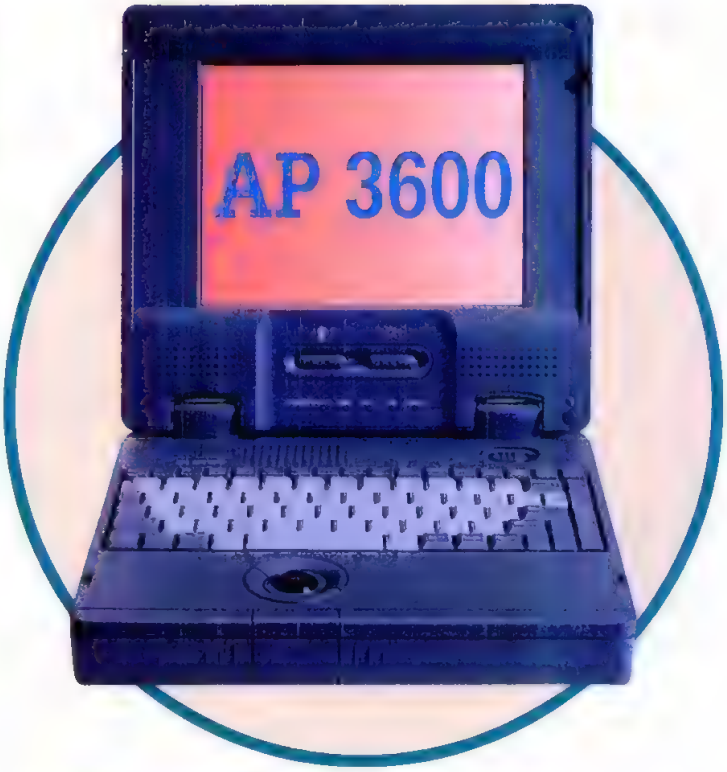

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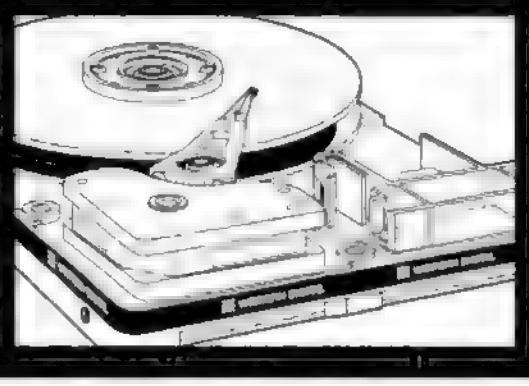

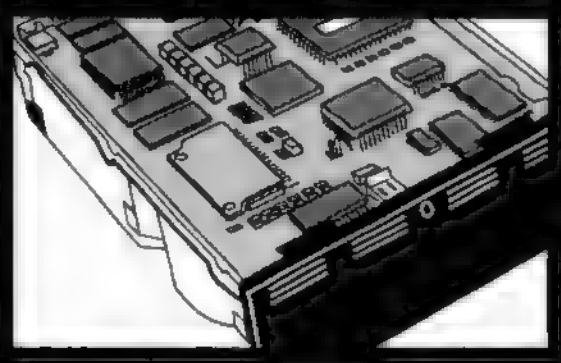

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SCSI			
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540MB	11ms	AC2540	$379
730MB	10ms	AC2700	$559
1083MB	10ms	AC31000	$739

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Quantum

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342MB	12ms	LPS340A	$269
541MB	12ms	LPS540A	$379
SCSI			
170MB	14ms	LPS170S	$199
270MB	12ms	LPS270S	$245
342MB	12ms	LPS340S	$272
541MB	12ms	LPS540S	$399
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CDU561	$429	$459	$469	$519
XM3401	$459	$489	$519	$559
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CDR510	$939	$1999	$3499
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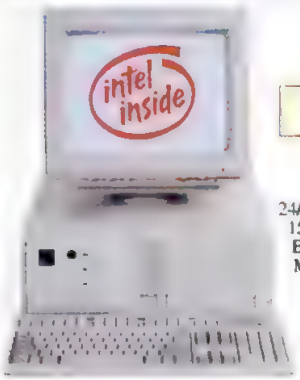

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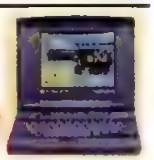

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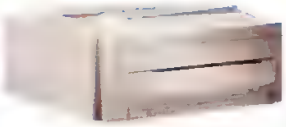

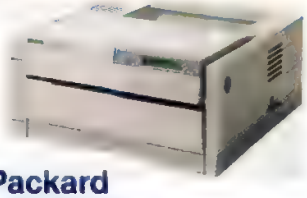

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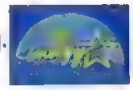

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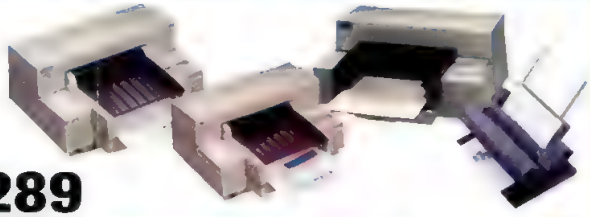

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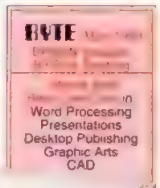

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EPSON DOT MATRIX PRINTERS

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AP 3250	$162	LQ-1170	$598
AP 3260	$179	LQ-2550 Clr.	$899
LQ-570+	$239	DFX-5000	$1319
FX-870	$268	DFX-8000	$2249
FX-1170	$349	Stylus 300	$229
LQ-1070+	$364	Stylus 800	$249*

*After $25 mail-in rebate. Ends 6-30-94.

CANON PRINTERS

BUBBLE JET PRINTERS

BJ-10SX Portable	$219*
BJ-200e Narrow Carriage	$259*
BJ-230 Wide Carriage	$359*
BJC-600 Color	$549*
BJC-800 Color	$1469*
BJC-820 Color	$1599*

LASER BEAM PRINTERS

LBP-430 /LBP-860	$559* / $1339*

*After $30 mail-in rebate.

PANASONIC PRINTERS

LASER PRINTERS

KX-P4400	$499	KX-P4440	$999
KX-P4410	$529	KX-P5400	$799
KX-P4430	$659		

DOT MATRIX PRINTERS

KX-P1150	$129	KX-P3123	$249
KX-P2023	$199	KX-P3124	$319
KX-P2123	$239	KX-P3624	$399
KX-P2124	$309		
KX-P1624	$369		

NEC PRINTERS

Silentwriter Model 1097	$1379
Silentwriter SuperScript 610	$479

TEXAS INSTRUMENTS

microWriter	$519
microWriter PS23	$679
microWriter PS65	$939
microMarc™	$249*
microMarc Color	$389
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**After $60 mail-in rebate.
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SHARP PRINTERS

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20" GDM-2036S	$1949
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ATI VIDEO CARDS

GRAPHICS ULTRA+ 2MB	$215
GRAPHICS ULTRA™ PRO 2MB ISA/VLB/EISA	$329/$329/$399

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Stealth PRO 1MB ISA/VLB	$219/$229
Stealth PRO 2MB ISA/VLB	$289/$299
Viper VLB 2MB	$339

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Dynamite Pro ISA 1MB/2MB	$159/$199
Dynamite Pro VLB 1MB/2MB	$159/$199
Graphite Pro ISA 1MB/2MB	$249/$379
Graphite Pro VLB 1MB/2MB	$249/$379
Graphite 2MB Upgrade Kit	$159

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Fahrenheit 1280+ 1MB ISA/VLB	$139/$159
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4400/4410 Lasers ..... $509/$535
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Canon

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BJ 200E $255*
BJ 230 ..... $359*
BJC 600 ..... $535* (COLOR)

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INNOVA NOTEBOOKS

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NOTEJET 486 SX33 120 MG $1849
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NOTEJET 486 SX 33Mhz 120 MG Color $2439
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SATISFAXTION 400 EXT 14.4/9600 .. $295
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CONNER 340MB SCSI $329
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COLORADO JUMBO 250 ..... $159
COLORADO JUMBO 120 ..... $119
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COLORADO 4 GB EXT $1399
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CONNER 250 MB EXTERNAL $289
QIC 80 TAPES $20

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PC ANYWHERE HOST REMOTE $99
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486 DX2-40 200 MB Color $2889
486 DX2-50 200 MB Mono $2389
486 DX2-50 200MB ACTIVE Color ... $3299
486 4000E DX4-75 Mhz $4439

SHARP

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Mitsubishi Diamond Scan 15FS ... $409
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LZR 1580 (11x17, 800dpi, 2 trays, 8MB)	5999
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SelectPress 600 / SelectPress 600 +	4627 / CALL
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Deskjet 540C, Deskjet 540 with ADF	299 / 389
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Transcend Memory.	
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4039 Laserprinter 16L, PS 600dpi, LAN	2699
LaserMaster WinPrinter 800	1098
WinJet 800 / WinJet 1200 Plus	399 / 699
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[illegible]	
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Texas Instruments Microwriter Basic 5ppm,	519
Microwriter PS 21 5ppm, 300 DPI, 23 fnts	679
Microwriter PS 65 5ppm, 300 DPI, 65 fnts	939
Microlaser Pro 600 PS 23 600 DPI	1369
Microlaser Pro 600 PS 65 600 DPI	1529
XLI LaserPix 5.0 (1200 / 2400 dpi upgrd)	1189
ImageXpert 500LE / 5000	5129 / 5799

Laser Printers

Canon [illegible]	[illegible]
DataProducts Jolt PSI: (solid ink)	4689
Largo Primera (thermal wax printer)	699
Primera Dye Sublimation Option	219
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Paintjet XL 300 / with 6MB	2258 / 2695
Deskjet 1200C / Deskjet 1200C PS	1499 / 2199
IBM Lexmark 4079 Color Jetprinter PS	2469
Kodak ColorEase	CALL
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ScanMagic 256 400dpi, 256 grays, Win.	115
ScanMagic Color 400dpi, 18 bit color, Win.	229
Paragon 256 800dpi, Photoshop LE, OCR	199
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Pro Audio Spectrum 16	99
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Sound Blaster AWE 32	$279
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Picture Publisher 4.0	488
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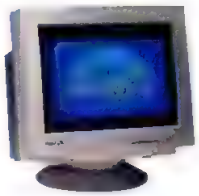

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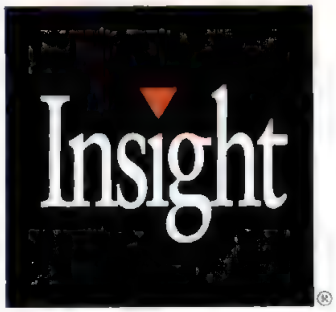

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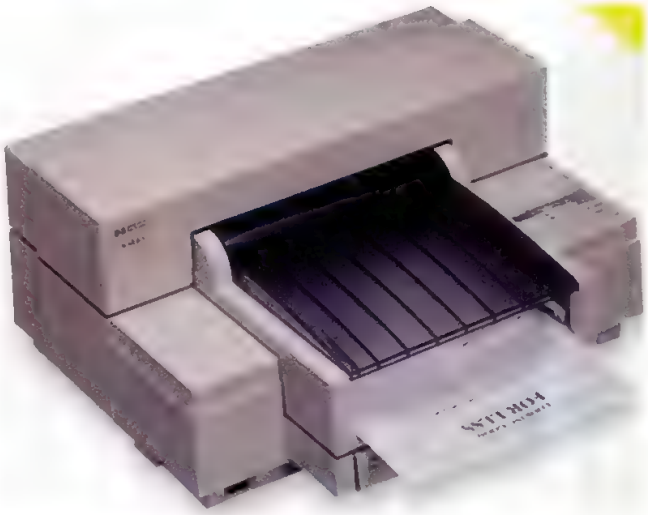

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213MB	14ms	3.5" 1"H	Conner	IDE	CFS21ØA	219
250MB	12ms	3.5" 1"H	Western Digital	IDE	WD225ØA	219
260MB	16ms	3.5" 1"H	Seagate	IDE	ST329ØA	219
270MB	12ms	3.5" 1"H	Quantum	IDE/SCSI	QULPS27ØA/S	239/269
270MB	12ms	3.5" 1"H	Western Digital	IDE	WD127ØA	229
340MB	12ms	3.5" 1"H	Western Digital	IDE	WD234ØA	269
340MB	15ms	3.5" 1"H	Maxtor	IDE/SCSI	MX7345A/S	289/349
340MB	12ms	3.5" 1"H	Seagate	SCSI	ST339ØN	379
340MB	12ms	3.5" 1"H	Conner	IDE/SCSI	CFA34ØA/S	309/349
340MB	12ms	3.5" 1"H	Quantum	IDE/SCSI	QULPS34ØA/S	279/299
340MB	13ms	3.5" 1"H	Seagate	IDE	ST3391A	269

420MB to 700MB

420MB	12ms	3.5" 1"H	Western Digital	IDE	WD242ØA	289
420MB	14ms	3.5" 1"H	Seagate	IDE	ST3491A	289
426MB	14ms	3.5" 1"H	Conner	IDE	CFS42ØA	359
452MB	12ms	3.5" 1"H	Seagate	IDE/SCSI	ST355ØA/N	339/529
510MB	12ms	3.5" HH	Fujitsu	IDE	FJ2624A	499
520MB	12ms	3.5" 1"H	Fujitsu	SCSI	FJ2624S	489
540MB	12ms	3.5" 1"H	Western Digital	IDE	WD254ØA	389
540MB	12ms	3.5" HH	Seagate	IDE/SCSI	ST3655A/N	389/589
540MB	12ms	3.5" 1"H	Quantum	IDE/SCSI	QULPS54ØA/S	479
540MB	10ms	3.5" 1"H	Conner	SCSI	CFA54ØS	679

1 GIG to 1.9 GIG

1050MB	10ms	3.5" HH	Micropolis	IDE/SCSI	MC221ØA/AV	779/899
1050MB	10ms	3.5" HH	Micropolis	SCSI	MC411ØS	779
1050MB	9.5ms	3.5" 1"H	Seagate	SCSI	ST312ØØN	769
1060MB	9.5ms	3.5" HH	Conner	SCSI	CFP1Ø6ØS	899
1070MB	10ms	3.5" 1"H	Digital	SCSI	DE31Ø7S	999
1080MB	10ms	3.5" 1"H	Fujitsu	SCSI	FJ2694S	799
1080MB	9ms	3.5" HH	Quantum	SCSI	QUEM1Ø8ØS	779
1225MB	10ms	3.5" 1"H	Quantum	SCSI	QUPD1225S	949
1260MB	12ms	3.5" HH	Toshiba	SCSI	MK538S	969
1337MB	9.5ms	3.5" 1"H	Digital	SCSI	DE3133S	1,199
1600MB	9.5ms	3.5" HH	Digital	SCSI	DE316ØS	1,299
1626MB	10ms	3.5" HH	Micropolis	IDE	MC2217A	1,099
1690MB	10ms	3.5" HH	Micropolis	SCSI	MC2217AV	1,199
1700MB	8ms	3.5" HH	Seagate	SCSI	ST1195ØN - Barracuda	1,449
1700MB	9ms	3.5" HH	Seagate	SCSI	ST119ØØN	1,089
1750MB	10ms	3.5" HH	Micropolis	SCSI	MC2217S	1,079
1800MB	10ms	3.5" HH	Quantum	SCSI	QUPD18ØØS	999

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2100MB	11ms	5.25" FH	Micropolis	SCSI	MC1926	1,399
2100MB	10.5ms	3.5" HH	Seagate	SCSI	ST124ØØN	1,449
2100MB	8ms	3.5" HH	Seagate	SCSI	ST1255ØN - Barracuda	1,699
2900MB	11ms	5.25" FH	Seagate	SCSI	ST434ØØN	2,099
3000MB	10ms	5.25" FH	Micropolis	SCSI	MC1936AV	2,149
3000MB	11.5ms	5.25" FH	Micropolis	SCSI	MC1936	2,069
3000MB	12ms	5.25" FH	Digital	SCSI	DE53ØØS	2,349
3572MB	12ms	5.25" FH	Digital	SCSI	DE535ØS	2,599
4000MB	12ms	5.25" FH	Digital	SCSI	DE54ØØS	2,799

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- -Data Cable
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- -Screws
- -Jumper Blocks
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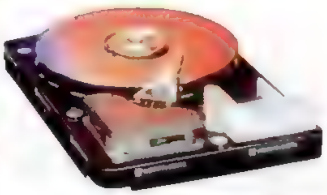
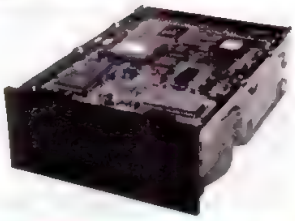
32 BIT AND MAC KITS ALSO AVAILABLE





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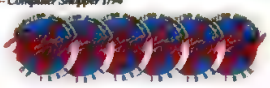

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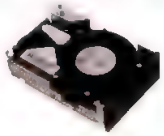

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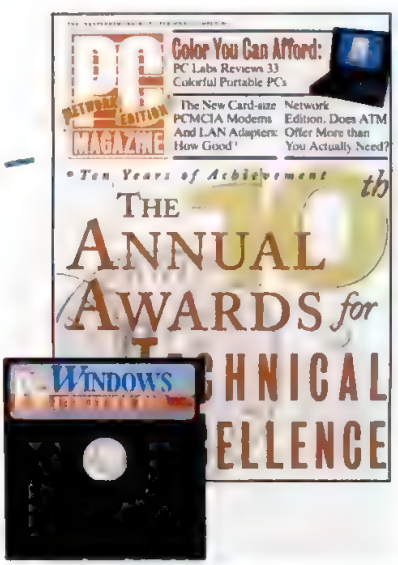

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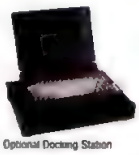
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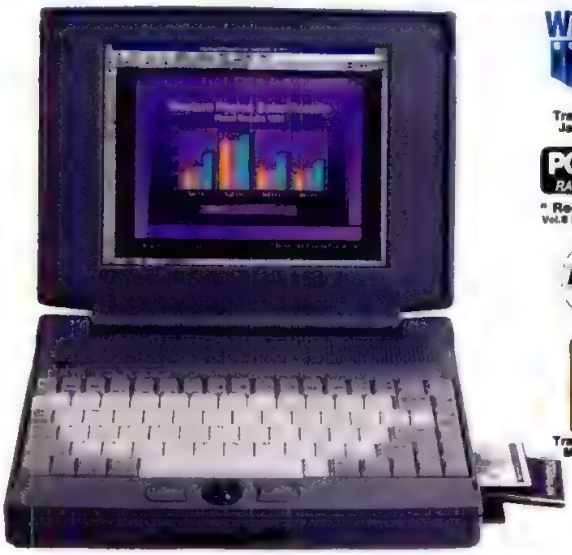

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	486SL-33	486SL-25	486SL-33	486DX2-50	486DX2-50	486DX2-50	486DX4-100
	1024x768	800x600	800x600	800X600	800X600	1024x768	1024X768
	No	No	Yes	No	Yes	Yes	Yes
	No	No	No	No	No	No	Yes
Built-In Center Trackball	Stick	No	Yes	Yes	No	No	Yes

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Feature	VTech	DELL	Gateway	Zeos
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Hard Drive	426MB	450MB	424MB	426MB
Floppy Drives	3.5"	3.5"	3.5"	3.5"
Video	1 MB VLB	1 MB VLB	1 MB VLB	1 MB VLB
3 Year warranty*	Yes	No	No	No
Double Speed CD-ROM	Yes	Yes	Yes	Yes
Sound Card & Speakers	Yes	Yes	Optional ($132)	Optional ($148)
Modem	Yes	Optional ($79)	Optional ($49)	Optional ($49)
Remote Diagnostics Sftw.	Yes	No	No	No
Case	Full Size	Desktop	Baby AT	Desktop
External Cache	128K	128K	128K	No
Monitor	15"	15"	15"	Upgrade ($95)
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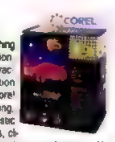

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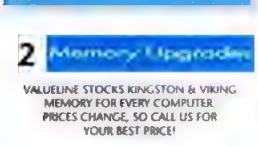

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Arlington Computer Took a Long Term Business Perspective but Used PC Magazine for Immediate Results.

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Arly Guenther
President, Arlington Computer

"When we started the company in early 1984," says Arly, "we believed that our success as a direct marketer would be tied to customer satisfaction. So we attempted to go into the direct advertising arena. Our strategy was to sell branded products at competitive prices while continually responding to the changing needs of our customer base. Two or three years ago, people might wait two or three weeks for a product. Now they want it overnight, and they want much more sophisticated technical support. After ten years of being in business, we really feel that our support is among the best in the industry."

When Arly chose the direct marketing channel, he knew the best way to maximize the return on his investment was to target business buyers that have enterprise-wide buying responsibility and buy many products in volume. He selected PC Magazine back in 1986 because its readers have the knowledge and responsibility to buy products for themselves and their organizations. In fact, because of the large volume buying, "PC Magazine has become Arlington's flagship publication, because its buyers buy many different types of products resulting in high average order sizes. All of this brings more revenue to the bottom line, and has allowed Arlington to grow to its present size."

"If you're in direct marketing for the long term, PC Magazine is an excellent choice. We run ads in PC Magazine consistently and have not missed an issue since day one." As a result, "last year alone our sales from PC Magazine were up over 30%." So, if you want your advertising message to reach the broadest, most sophisticated customer base, PC Magazine is definitely the place to be.

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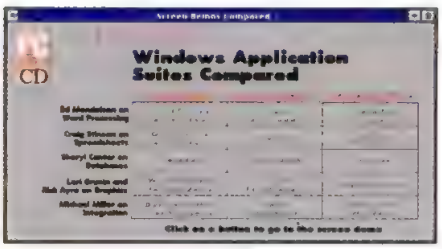

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How PC Direct Helped Computer Discount Wa Found "Customer Univ

All the employees at the Computer Discount Warehouse are still in school. No, they're not teenagers anymore, but they're all enrolled in a program called CDW University — which they also call "Customer U."

"We believe that the only way to grow is to make the customer #1," says Michael Krasny, the company's CEO. "That's why we established an on-going, mandatory training program that focuses on customer service and product briefings. Our employees also have personal, hands-on experience of a lot of the products they sell — and they know how to treat the customer right."

The customer support program at CDW, a ten-year-old reseller of PC hardware and software, includes free technical support from 8 a.m. to 7:30 p.m. "We guarantee that support calls will be answered within three minutes," says Krasny. He also points out that a $10 million product inventory makes it possible for the company to provide same-day order shipment.

Computer Discount Warehouse has turned their success into an opportunity to offer better customer service, and Krasny singles out his advertising in PC Magazine as the cornerstone of his success. "We've been in the PC Direct section since 1986, and we've never missed an issue. Our most loyal customers, the ones who appreciate service, come to us through PC Magazine. No matter how you look at it — closing rate, calls per ad dollar — PC Magazine is tops."

If you're a direct marketer and you're looking for one million prospects who understand value and service, look no further than PC Direct. There's no better way to attract so many loyal, repeat customers.

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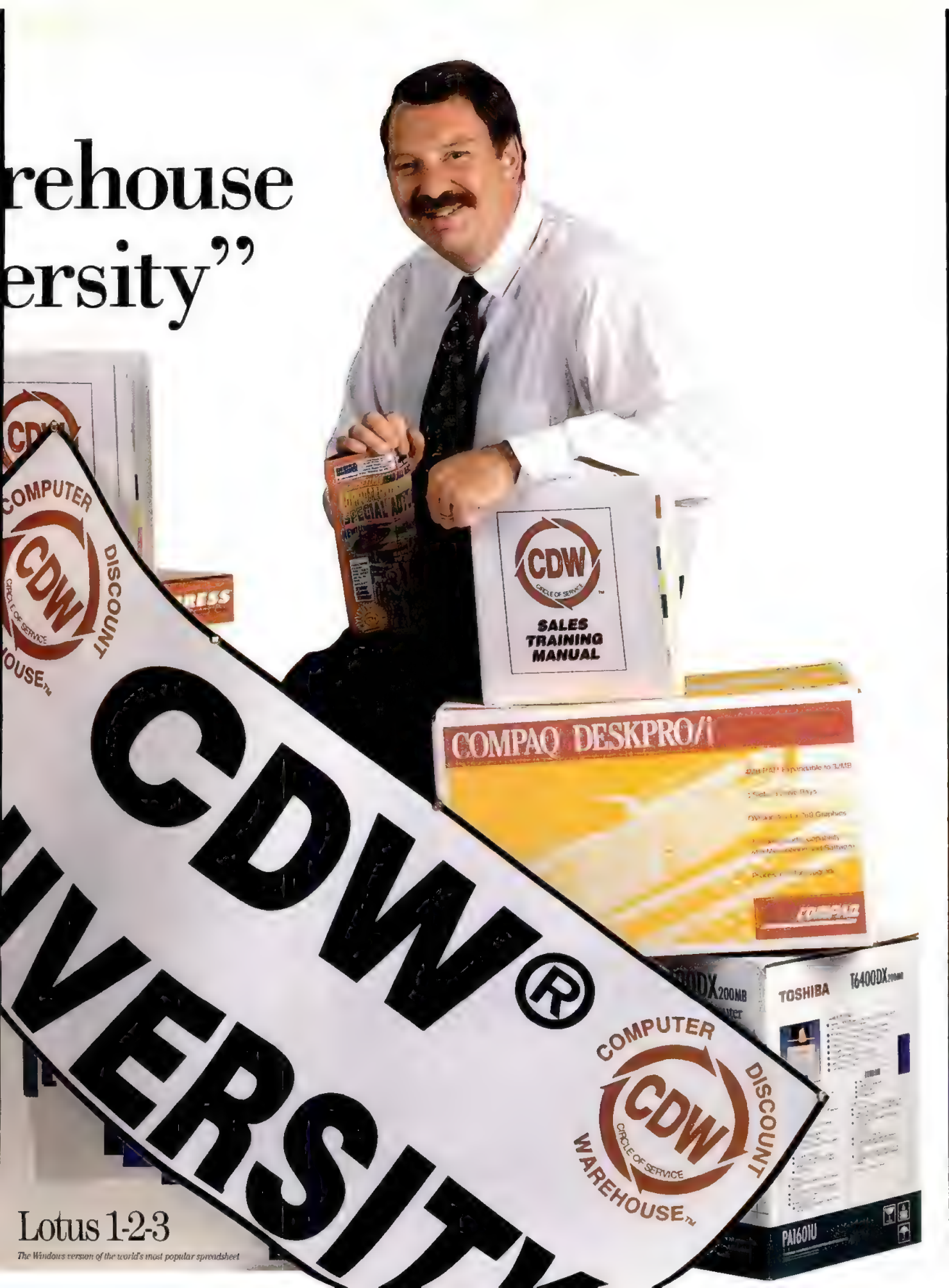
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CIRCLE 158 ON READER SERVICE CARD

PC MAGAZINE MARKETPLACE

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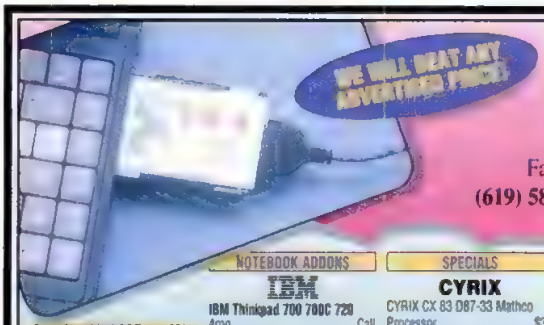

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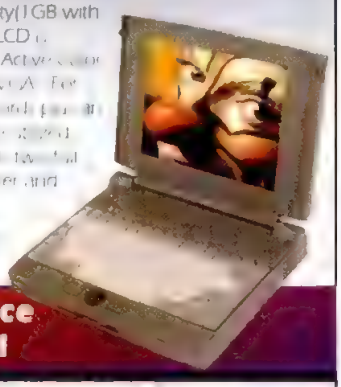

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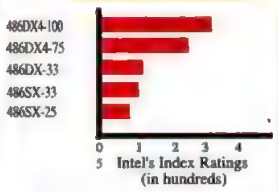

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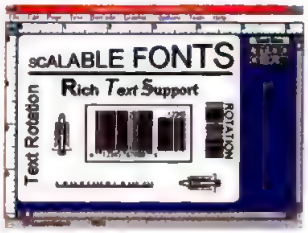

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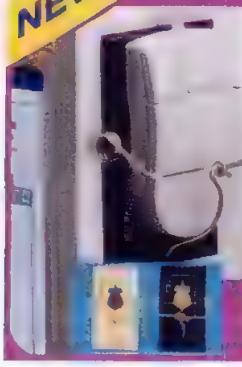

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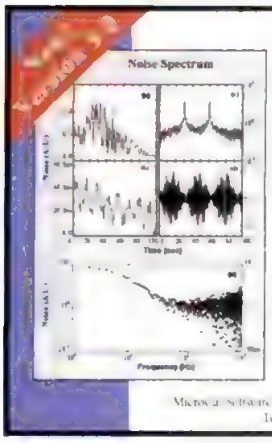

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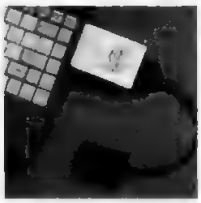

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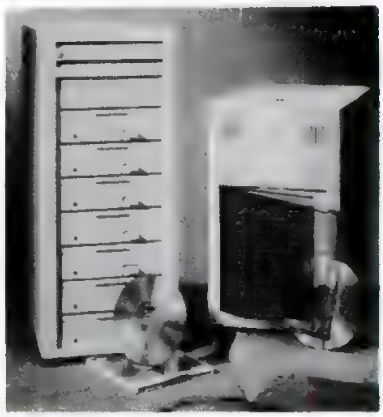

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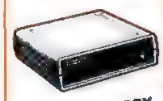
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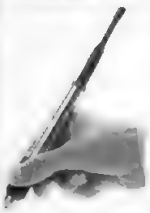

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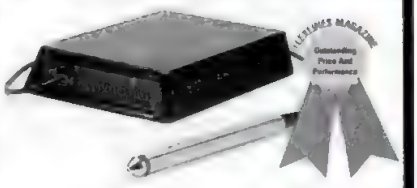

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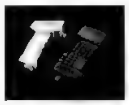

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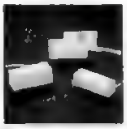

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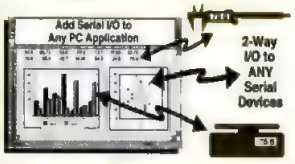

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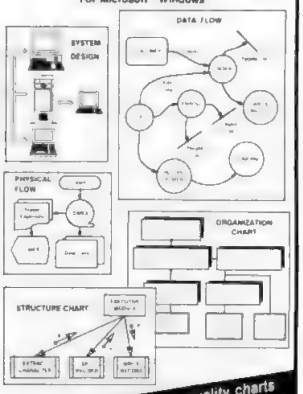

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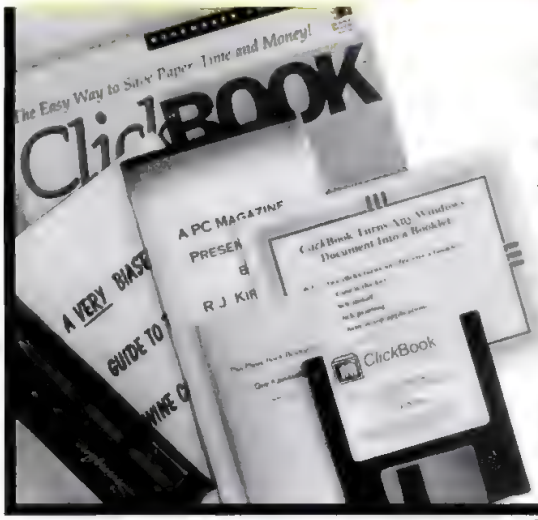

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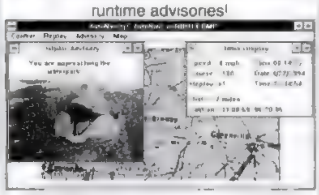

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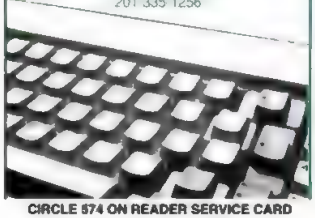

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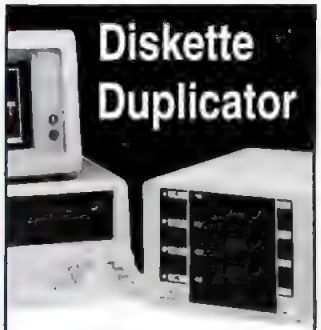

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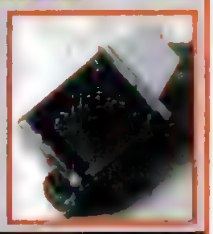

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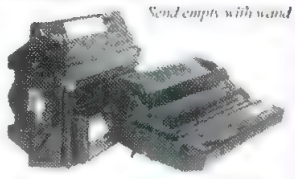

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PC MAGAZINE

Coming Up

The Perfect PC

We can dream, but the perfect PC always seems to elude us. As processor, video, and expansion bus technologies continue to evolve, the image of the perfect PC system changes as well. We analyze today's technologies and take a peek at the future.

Building Perfection What's the perfect system? The answer depends on you. We offer our recommendations for seven perfect systems ranging from a subnotebook to a sky's-the-limit, to-heck-with-the-budget desktop dream system.

Upgrades and Other Options Is your PC the best it can be? Does it need additional cache memory or a complete motherboard upgrade? We weigh some options and offer some upgrade and enhancement suggestions.

Service and Reliability Once you have your PC, what happens if something goes wrong—or if you just need help? Our readers tell us which vendors respond best to their customers.

The Perfect LAN After you've chosen your perfect PCs and perfect peripherals, you'll want to put them on the perfect LAN. What topology should you use? Cabling? Hubs? We examine several different-size LANs, address some other connectivity issues, and look at some high-speed options for the future.

The Perfect Hard Disk How much disk capacity is enough? When is SCSI a better choice than IDE? What's the best solution for disk cache? We give you all the answers—and discuss new developments in disk and controller technology.

The Perfect Multimedia Add-On Multimedia is going mainstream! We tell you what to look for in CD-ROM drives, sound cards, and speakers—and give you some buying hints that may help prevent installation nightmares.

The Perfect Display The Perfect PC wouldn't be complete without the perfect display. But besides the ideal monitor, you'll need a graphics card that's tailored to your needs. Here's how the perfect display system should work.

The Perfect Software On the software side of perfection, we conjure up an interface for the perfect application—and assemble the perfect utilities toolkit.

Support and Satisfaction Our readers tell us how satisfied they are with the current crop of software. We also include a chart of vital statistics on software providers and do some real-world tech-support investigating.

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After Hours

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Finding a New Career Digitally

The typical American worker could once expect to change employers just once or twice during a career, but now estimates say that workers of the future may hold seven or eight different jobs over the course of a career.

Changing jobs has never been easy, but with your PC at your side, the whole process can be a little less traumatic. These seven packages offer everything you need for the hunt, from basic résumé-writing tips to career counseling to interview advice. They're the next-best thing to having a personal headhunter on call.

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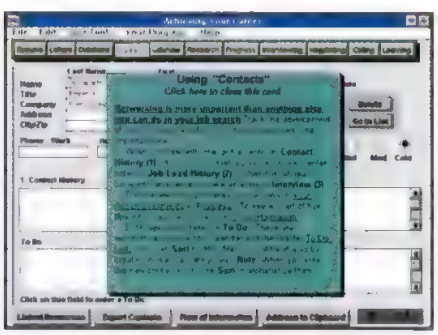
If all you need is some basic guidance in finding a new job, this set of tools for job seekers may fill the bill. More a job-hunt tutorial than a resource guide, Achieving Your Career offers a smattering of everything. There's a database of 800 national companies and sections on making and using contacts, doing research, interviewing, negotiating, and calling potential employers. The questions and sample answers provided in the interviewing and negotiating sections offer good advice.

In addition, the package includes a rather weak résumé writer with only eight sample résumés and no built-in text editor. To convert these samples into a working résumé, you'll have to use your own word processor.

Aside from the searchable database of companies, there's little in Achieving Your Career that can't be found in a good book.



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If your approach to finding a job is to mail résumés in quantity and hope for a response, then JobHunt is the package for you. This is basically a mail/merge program with a 6,000-company database that you can search by region and type of job.

Companies are categorized by 200 SICs (standard industrial classifications), ranging from advertising to wire products. When searching, you can select multiple SICs and regions of the country. If you want to target financial and investment institutions in Texas, this is the way to do it.

When your search is complete, you can display or print the results, which include contact data as well as statistical information such as annual sales and number of employees. The hits can also be easily merged with a cover letter for assembly-line efficiency, although the included word processor is decidedly low tech.

JobHunt is basically a one-trick pony, but it's not a bad trick.

JobHunt provides all the company information you're likely to need for a mass mailing.

Job Power Source

InfoBusiness; 800-657-5300

Circle 494 on reader service card

★★★★ WIN CD $59.95

Job Power Source is the ultimate multimedia training course for finding a job. This CD-ROM contains the full text of 11 career books written by career experts Ron and Caryl Krannich, as well as the government's *Occupational Outlook Handbook*. Textual information is supplemented and enhanced by almost 2 hours of video from award-winning trainer Pat Sladey, who lectures on topics such as methods of finding jobs and getting contact names.

Scores of interactive worksheets focus on specific topics like discovering your work style and skills and setting career goals. Although there's no built-in word processor/résumé

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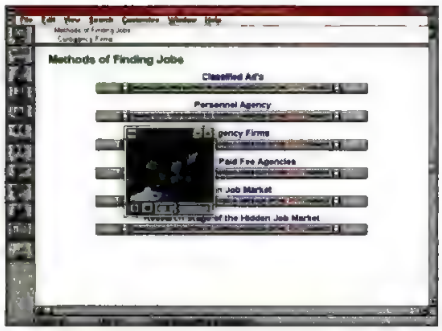


Instructional videos lie at the core of Job Power Source.

writer, the package does include 200 sample résumés.

This is an excellent resource that should be in every high school and college.

Resume Writer

Expert Software, 800-759-2562

Circle 495 on reader service card

★★★ WIN $14.95

Low price isn't always an indication of low quality. This inexpensive résumé and job-search system offers a straightforward, efficient approach. It comes with over 100 sample résumés for all kinds of jobs including executive, clerical, and trade positions, as well as a good selection of cover letters for everything from responding to a newspaper ad to working your contacts. The résumé templates also allow you to choose either chronological or functional format. There's also a contact manager and an appointment calendar for tracking dates, names, and addresses. You can use the built-in word processor to insert names and addresses from the contact manager to your cover letter. And because the word processor uses a mulitple-document interface, you can edit several résumés and cover letters at the same time.

Creating a résumé is simply a matter of filling in the blanks in the templates. To be sure your résumé is accurate, there's a pop-up guide to action verbs and a built-in spellchecker. When you're ready to print, you can fine-tune the fonts and formatting so that the output will be attractive and professional looking. No muss, no fuss, just good-looking résumés.

Resume Writer may not be the most full-featured program, but at $14.95, it's easy to like.

WinWay Job Interview

WinWay Corp.; 800-494-6929

Circle 496 on reader service card

★★★ WIN $69.95

Practice makes perfect. That's the idea behind WinWay Job Interview, which poses 200 typical interview-type questions for you to ponder and respond to. Questions are organized into topics such as experience, teamwork, education, and performance and can be timed to appear at set intervals.

If you have a sound card, you can hear interviewers ask questions like, "What makes you angry?" Or you can rely on your PC's built-in speaker. Along with each question, you'll receive a hint explaining the key elements of a successful answer, as well as an example of just such a response. Of course, you're encouraged to form and type your own answer before looking at the professional suggestions. Of particular interest are the sections on stressful and illegal questions and how to handle them. There's also a strategy section that covers all aspects of preparing for an interview, from what to wear to what questions to ask.

PROBLEM SOLVER

During an interview, avoid discussing negative factors like unpleasant work environments, poor management, or personality conflicts. Nobody wants to hire a complainer, even if the complaints are justified. Turn the negative into a positive by explaining what you've learned.

You can fill out an evaluation sheet for each answer, and the program will generate a summary with charts and graphs so you can track your strengths and weaknesses. Because no interview is complete without a follow-up, the program includes a handful of sample thank-you letters.

WinWay Job Interview has all the tools first-time interviewees and nervous applicants need to build confidence and nail that job.

WinWay Resume, Version 2.0

WinWay Corp.; 800-494-6929

Circle 497 on reader service card

★★★ WIN $69.95

When it comes to creating an attractive résumé, WinWay Resume is the hands-down favorite. This package includes more than 100 sample résumés in areas such as administration, sales, management, technical, creative, and education, and using those samples is a snap.

Selecting the organization and style of your résumé is as simple as choosing from a series of dialog boxes. Once you've typed in your name and address, for example, you can choose any of 18 type and format styles. The same concept is used in other sections like education and job experi-

CNN Time Capsule 1993

CD-ROM PICK HIT

News junkies who want to relive the drama and pathos of 1993 will love CNN Time Capsule 1993: 100 Defining Moments of the Year, which draws the bulk of its content from the CNN broadcast files. You can simply sit back and watch the Year in Review documentary, which includes video footage of the year's defining moments, including the Middle East Peace Accord, the Branch Davidian fiasco in Waco, and the retirement of Michael Jordan, or you can skip around by category or keyword. You can mark clips for easy retrieval.

The interface takes a little getting used to, but the news reports and video footage are first-rate. Look for annual updates to become must-haves for video and news junkies alike.

—Gayle C. Ehrenman

Vicarious Entertainment, 415-261-1900

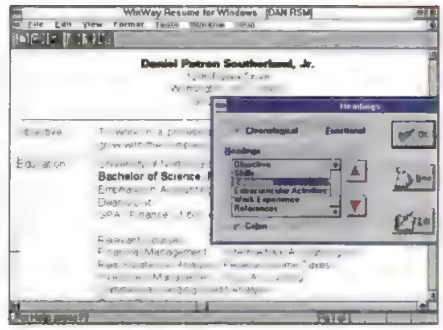
Circle 489 on reader service card

★★★ WIN $29.95

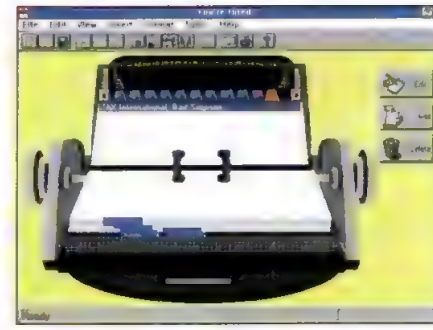
ence: You simply click on a section in the sample, and then enter your information. If you don't like the appearance, click a button to reformat the data. To ensure grammatical accuracy, you can consult the on-line active-verb glossary and built-in spell-checker.

To add graphic impact, you can choose from a selection of borders, bullets, and colors. The program will automatically adjust the spacing to accommodate your embellishments.

WinWay Resume 2.0 doesn't offer the bells and whistles of career-guidance software, but it's got everything you need for creating powerful résumés.



Creating a résumé is a point-and-click process with WinWay Resume.



A contact manager is one of the extras included in You're Hired.

You're Hired

DataTech Software Inc.; 800-556-7526

Circle 498 on reader service card

★★★ WIN $59.95

You're Hired combines a career counselor, résumé writer, contact manager, and interview adviser under one umbrella. The package can help you with every step of a job search, from choosing a career to following up on interviews.

For help in finding the right job, turn to the Career Counselor, which takes your answers to a series of question and produces a list of vocational choices.

When you're ready to write your résumé, you can choose from dozens of job descriptions and titles, which include statements of duties, skills, and job functions. If you need help choosing a résumé style, Selection Assistant will recommend the most appropriate format based on your answers to 12 key questions. For writing cover letters, there's a complete word processor and a contact manager for storing names, addresses, and appointments.

If the interviewing process stumps you, the Interview Assistant should be your first stop. This section guides you through preinterview research on the company you're interviewing with and produces a checklist of information and interview tips. Landing the job is up to you.

— Don Trivette

MOVING?

Please write to: PC Magazine, P.O. Box 54093, Boulder, CO 80322. Include your mailing label from a recent issue of PC Magazine for faster service. Please allow up to 60 days for change of address to take place.

Reference

Finding the Perfect Place

InfoNation—Rating the U.S.A. to Z

Software Marketing Corp.; 602-893-3377.

Circle 491 on reader service card

★★★ $49.95

Looking for a warm-weather vacation spot heavy on wax museums and top-rated restaurants? How about a new place to live that has real seasons, a diverse culture, and plenty of bookstores? Whatever your reasons, concerns, and interests, if you're looking for a place, InfoNation—Rating the U.S.A. to Z stands a good chance of helping you find it.

InfoNation ranks locales by any combination of 1,200 criteria.

This reference tool lets you rank states and 300 or so metropolitan areas based on any combination of 1,200 criteria. Much of the supporting data, which was culled from publications of the U.S. Census Bureau and 36 other sources, constitutes the sort of mundane though helpful information you might expect—including population by age, sex, race, marital status, and education level.

The real charm of the package, though, lies in the addition of the stuff fun and fulfillment are made of, such as arts and sports, and the control the software provides in determining the weight of any given factor. Most of us will find at least a few topics we care about, but few of us will demand that our own little Eden rank high in everything: InfoNation lets you set the weight to be given to each topic across any or all of the software's ten data categories.

InfoNation also provides detailed, multilayered graphics of the United States, can generate graphs and map overlays to illustrate rankings, and supports map export.

—Mitt Jones

QUICK CLIPS

Recommended · It's Your Call · Not Recommended

Civix

If balancing your checkbook isn't challenging enough, take a crack at the federal budget. Like the deficit, it's a struggle, and it isn't pretty. *$52.95; Cogus International; 800-347-2251.*

CyberTarot

Perfect for those times when you'd rather be divining the future than toting up that spreadsheet. Good graphics, strong interpretations, and all the layouts a good fortune teller will ever need. *$39.95; Axis Mundi; 312-866-8035.*

Microcosm

Journey through various body parts and shoot things. It's been done before, but the Rick Wakeman–scored sound track is original. *$69.00 (estimated street price); Psygnosis; 617-497-5457.*

Multimedia Kaleidosonics

Like wow! Nature scenes, an audio sound track, and endless ways to manipulate them. It's a hallucinogen for your PC. *$24.99; Masque Publishing; 800-765-4233, 303-290-9853.*

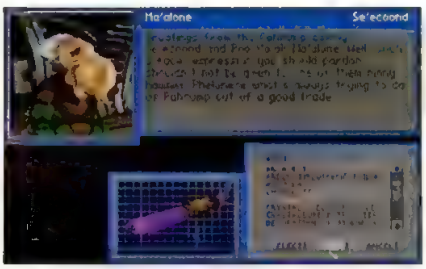
SPOTLIGHT ON ADVENTURE

Nomad Faces Off Against the Aliens

The problem you're faced with in Nomad is a Master Control Robot that's reprogramming the Korakian robotic race for total aggression and replication. The other galactic races are outnumbered and outgunned. As Earth's sole space-faring representative, the Nomad, it's up to you to stop the massacre. Along the way, you'll encounter 11 alien races, dozens of star systems, and hundreds of planets.

Nomad's aliens themselves are a delightful mix. In the tradition of Microprose's Hyperspeed, they are an anthropomorphic mix of samurai rabbits, ursine merchants, and walrus-like warriors, among others. Each representative of an alien species also reveals personal traits governing character response, dialog, trading, and battle.

Nomad's graphics are serviceable rather than flashy, and battle is simple in concept but difficult to master. The brief, digitized melodies that introduce communication with each species are woefully bad. Not so the conversations: Nomad's apparently diverse nonhuman languages have been created through frequency distortion and variable-speed recording techniques. Of course, your ship is equipped with a device that automatically displays translated text.



Talk, fight, and trade with 11 races of characters in Nomad.

The interface is as quirky as the languages. Three out of four of the lists of subjects you can "discuss" with aliens will eventually hold more than 150 items each, but there's no search function in sight. Still, there's much fun to be had in Nomad's universe.

— Barry Brenesal

Gametek Inc.; 305-935-3995.

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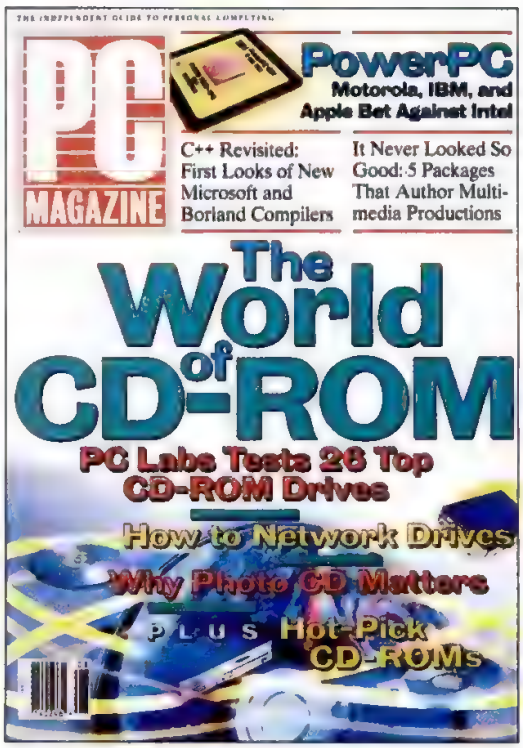

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Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

Top 5 Least Interesting Internet Newsgroups

5. Rec.arts.popsicle.stick.structures.
4. Rec.sport.figureskating.attacks.
3. Misc.misc.
2. Alt.sex.with.Dr.Ruth.
1. Rec.humorless.

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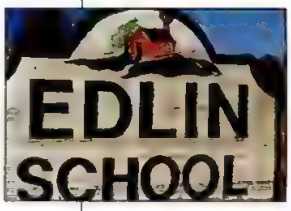


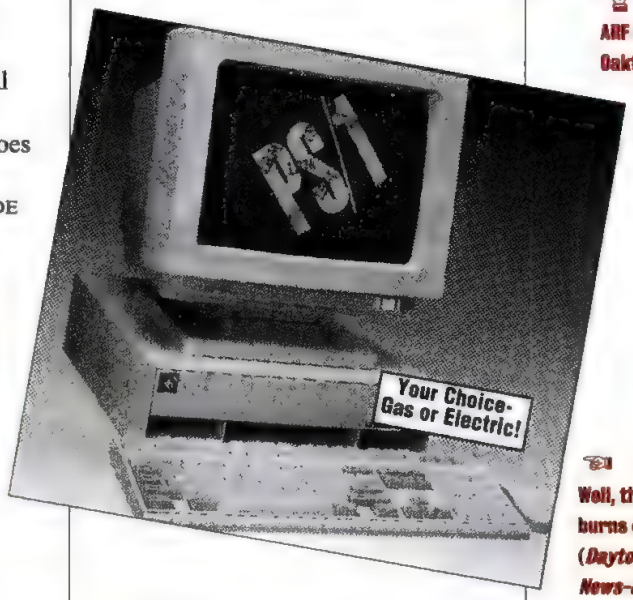
ARF on the road: Oakton, Virginia.

So What's That Snapping Sound?

"Slide the paper exit support in until it snaps securely into place.

"NOTE: The paper exit support does not actually attach to the printer."

—CANON BJ-230 QUICK START GUIDE



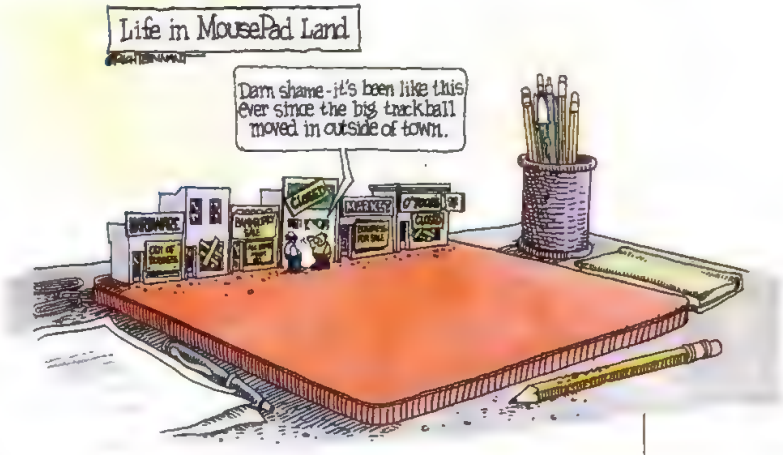
Well, they say gas burns cleanly.... (*Daytona Beach News-Journal*.)

All this computing makes me so tense. How can I relax? (J&R Music World catalog.)

It's So Tasty, Too

"To open another view of the same browser, lick the icon on the Tool Bar representing the browser you wish to open."

—ON-SCHEDULE FOR WINDOWS MANUAL



If your entry is used, we'll send you $50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine*, One Park Ave., New York, NY 10016-5802. Winners this issue: William Adams, Richard Angelo, Josef Davis, Josh Ferguson, Steven Mielke, and James Nelson.

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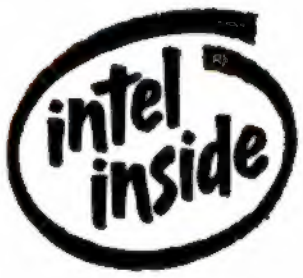
In their annual quest for the desktop PC with the highest customer satisfaction in the business, J.D. Power and Associates recently surveyed 1,956 business users of desktop PCs.‡ What did they discover? Dell owners were the most satisfied, which meant Dell earned the "J.D. Power and Associates Highest Customer Satisfaction Among Desktop PC Users Award" for 1993.



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